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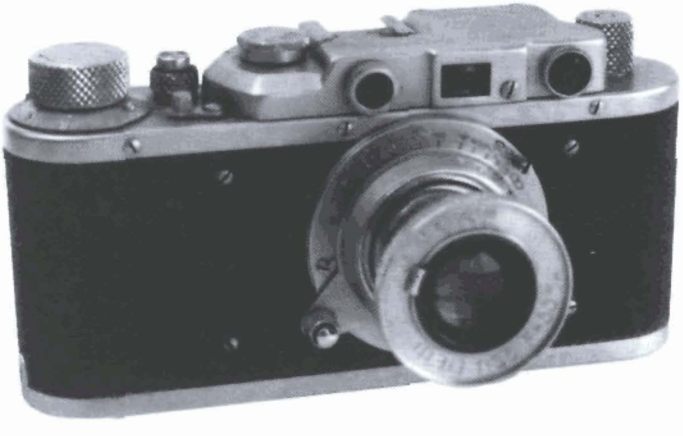
All You Need to Know About Design and Repair of Russian Cameras



A Collector's and Repairman's Handbook

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This book is dedicated
to my darling wife Ketti
and my son Leon

SPUTNIK

INTRODUCTION

In the past several decades we have seen a growing interest in optics and photo-cameras manufactured starting in the 1920's. The quality of Russian cameras of this period easily compares with that of the cameras produced by German, Swiss, and French companies. A special, new market has appeared in Europe, America, and Japan where these early cameras have a steadily increasing market value. There are at least two reasons for this recent upsurge in popularity. Russian optics and cameras are superior in quality, and many of these older models are still widely and successfully used by photographers. Both Russian cameras made in the twenties and thirties as copies of their German counterparts and later cameras of unique design have become collectors' items at many auctions throughout the world.

Prior to World War II, Russian camera manufacturers mainly copied the world- renowned cameras of German design. For example, the FED camera is an exact copy of Leica II. Well-established German companies, such as *Ernst Leitz*, *Zeiss Ikon*, *Voigtlander*, etc., are known as the pioneers in the design of photo equipment, 35 mm cameras in particular. The concept of the focal plane shutter invented by Oscar Barnack for Leica in the mid-1920's remains basically unchanged even in the state-of-the-art electronic cameras. Both collectors and experts know that early designs of Nikon and Canon were taken from the same Leica. Today these brands have the highest price on the market, and there is a special demand for their copies manufactured in different countries, particularly in Russia.

Starting in the mid-forties, uniquely designed cameras were built in Russia. Within the following twenty years Russia was annually manufacturing between two and five million photo and movie cameras, a great number of which was exported to seventy countries, including the US, Canada, the United Kingdom, and Italy. Russia became one of the largest manufacturers and exporters of photo equipment. Some of these cameras are highly priced as significant milestones in the development of Russian optics and cameras. Others meet up-to-date demands and continue to be used by both professional and lay photographers.

The number of available, well-preserved Russian cameras produced prior to 1970 has decreased dramatically over the last decade and will continue to do so, whereas the market value of these cameras will increase ever more sharply due to their scarcity. At the same time, there are fewer and fewer repairmen who are capable of repairing and restoring this type of photo equipment. Keeping their cameras in working condition is equally important for collectors who want to see their value increase and for those who use the cameras professionally or as a hobby.

In this book you will find a description of the most popular optics and cameras produced in Russia at that time. It contains information on the design, operation, and repair of forty-two brands of mechanical Russian cameras. Many of them, such as FED (Leica II), "Kiev" (Contax II), "Moscow-2" (Super Ikonta "C"), etc., were distributed by the thousands all over the world.

The first part of the book is a general introduction to the operations and functions of the cameras' basic parts. You will find here a list of instruments and tools required for camera repair and a description of the most common repair procedures. The second part contains a more detailed description of camera designs, assemblies and subassemblies, and speaks of how typical operational problems can be resolved. Each chapter combines cameras similar in design, for example "Smena", "Smena-2", "Smena-3", etc. The original models of each brand are described in the greatest detail while later models are viewed from the standpoint of introduced modifications. If you are not a professional, you will still find here the information you may need for minor to moderately complicated repair of your camera. Even the most comprehensive of books is unable to cover every possible type of malfunction and the method by which it is eradicated. Instead of only giving you step by step instructions, the book gives you an even more valuable tool. This tool is operational knowledge which you can use to solve any problems that may arise and are not described here. Even if you have no intention of repairing your camera on your own, you will find this book helpful in evaluating the camera's present condition and its market value. It is useful in different ways for photographers, collectors, appraisers, and repairmen.

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CAMERA

Correct Camera Handling

A camera is a high precision instrument. It can function for many years without requiring repair if it is handled correctly according to the manufacturer's manuals and protected against mechanical damage and dirt.

A camera must be kept in a case to protect it from shock and exposure to dust and dirt. Shocks and falls can damage some parts of the camera, especially the lens and rangefinder.

Upon penetrating the camera, dust and particles may scratch the film and may also cause premature wear of the mechanism's adjoining surfaces. The smallest sand grains may lead to camera failures if they get stuck in the gears' teeth.

A camera should not be stored in a humid environment because moisture induces corrosion of its metal parts and damages its optical parts as well as the lens coating. It is not advisable to operate the camera in bad weather. If droplets of moisture accidentally penetrate the camera, they should be wiped off immediately after the use of the camera.

The camera should not be subjected to sudden changes in temperature. During the wintertime, when the camera is brought inside from the cold, moisture condenses on its surfaces. The camera should not be taken out of its case until it warms up to room temperature.

If the camera has been immersed in water, especially sea water, it has to be disassembled and cleaned immediately.

Hold the camera only by the lower edge of the lens mount while taking it out of its case; do not touch the viewfinder's or rangefinder's glass surfaces.

Spare film cartridges should be kept in special cases (not in pockets), since dust accumulating on the cartridge velvet may scratch the film. Paint-stripped spots inside the camera must be coated with flat black paint.

Loading the Camera with Film

Correct camera operation largely depends on loading the film correctly because incorrect film loading may result in very serious damage. Camera repair experience indicates that numerous malfunctions are caused precisely by this circumstance.

All cameras are loaded with different types of film using a special lightproof cartridge and/or film loaded spool (depending on the film format).

The process of loading the cartridges (the regular kind and the two-cylindered split) is omitted in this book because it is described in detail in the camera manuals. The book familiarizes the reader with how to load the spool or the cartridge in the camera.

Let us first review the film loading of cameras with no removable back cover (FED, "Zorki", "Zorki-C", "Zorki-5", etc.). They are thought to be harder to load than the ones with a removable back cover. However, they too can be loaded quickly and easily if everything is done in a proper way.

Load the film as follows. First, check the shaped cut. The cut has to be positioned between the perforations (Fig. 1a); its edges should be rounded because sharp edges would be caught in every film track part. The width of the cut film end should be no less than 22 mm.

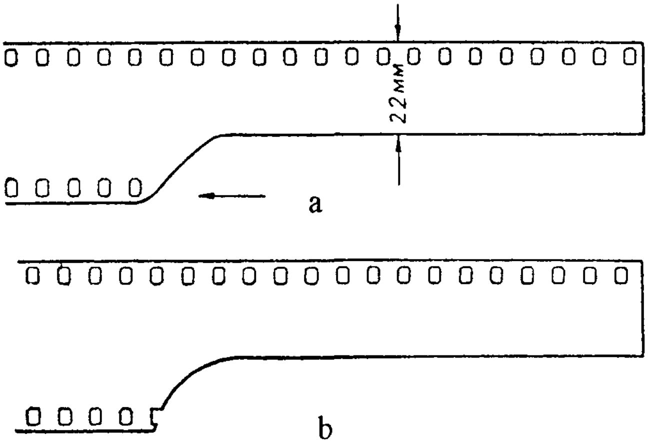

Figure 1. The film cut: a-right, b-wrong.

After the film cartridge is ready, the camera can be loaded. Having set the pointer with the baseplate lock handle to "Open", remove the cover and the take-up spool from the camera. The free-hanging part of the shaped film cut is affixed to the take-up spool (Fig.2.). Two or three

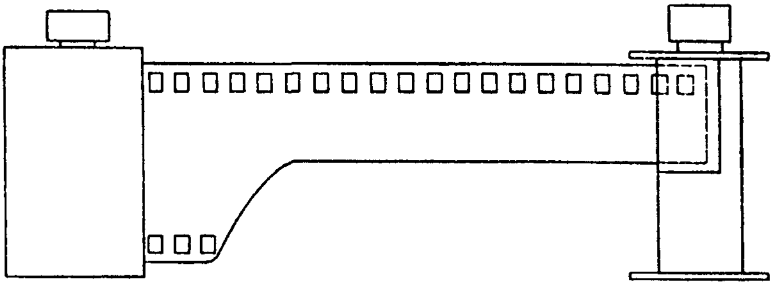

Figure 2. Correct positions of the cartridge, film, and spool before loading the camera.

perforation windows have to be showing out of the cartridge slot before the shaped cut. The length of the shaped film cut, including the cartridge and the spool, is approximately the same as the length of the camera. After the film end is fastened under the spool spring, it is necessary to shift the on-off switch mechanism lever, which releases the sprocket. In order to do that, the lever *10* is turned to the letter "B" (see Fig.116, cameras FED, "Zorki") or the knob *4* (see Fig.166, cameras "Zorki-2", "Zorki-C", "Zorki-2C", etc.). Then the spool and the cartridge are placed in the camera. The take-up spool is installed into the friction clutch (drum), and the film is inserted in the film track. It is recommended to do it on the cartridge side. If the cartridge cannot be lowered all the way down, the film release button has to be turned so that the rewind fork *6* (see Fig.118) would get into the cartridge spool hole.

After the cartridge and spool are inserted, the lever is shifted from the letter "B" back to its original position which puts the winding mechanism into gear. The shutter has to be turned slowly until the perforation windows are engaged with the teeth of the transport sprocket. (The correct position of the film on the transport sprocket teeth is shown in Figure 3.) The cover is then replaced, and the lock is closed. Skipping two frames, wind the shutter (at this point the film is advanced and set to the first frame), and set the exposure counter dial to 1. The camera is now ready for use.

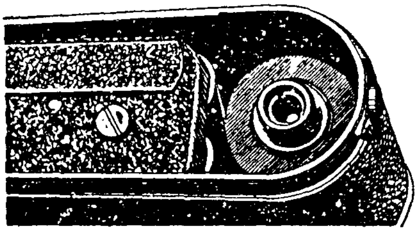

Figure 3. The correct position of the film on the transport sprocket teeth.

It is recommended to rotate the exposure counter dial in the direction of the winding knob rotation (clockwise) to prevent weakening of the brake spring *5* (Fig.125).

Load the cameras with the removable back cover (FED-2, "Zorki-3", "Zorki-4", "Kiev", etc.) as follows. The back cover is removed by lifting and turning the cramps of both locks halfway. Then, holding the camera in the left hand and placing the right hand on the back cover, slide the back cover out of the body slots and lift it by simultaneous motion of the right hand and the left thumb. After that, about 10 cm of the film are pulled out from the cartridge and attached to the take-up spool. The cartridge is placed in the camera so that the pin on the shutter body snaps into the cartridge chock. At the same time the take-up spool is inserted in the camera by setting it onto the drum of the friction clutch in a way that the film perforation is caught by the sprocket teeth.

After that the camera's back cover is put in place, and the locks are closed. With the turn of the lock catch, the cartridge automatically opens, and the film winds freely. If the lock does not turn, check whether the cartridge and back cover are positioned correctly.

To facilitate the closing of the lock, it is necessary to push the lock in the direction of the cassette while turning the lock's bracket.

If the camera is loaded correctly, the film transports smoothly when the shutter is being wound and the rewind knob rotates in the direction opposite to the arrow engraved on it.

If the film perforation breaks, immediately stop operating the camera and reload it.

The transport sprocket that feeds the film during loading must be in gear. If the sprocket is off, the film is pulled out of the cartridge only by the force of the take-up spool, and the film end could be pulled out from under the spool spring, stopping the film feeding.

When loading any 35 mm camera, always check the side flanges of the take-up spool. Bent flange edges have to be straightened with pliers. Otherwise, the film would be wound poorly which may result in camera malfunctions.

Medium format cameras use the spooled film. Some spools are made of wood, and the flanges are made of metal. The spool ends have two holes, one of which holds a cross slot for the transport mechanism fork. It may happen that the spool and holes are non-standard which would result in rotation problems and use of excessive force to transport the film. Force must not be applied when transporting the film. Instead, the camera has to be unloaded and reloaded with a replacement spool.

Choosing the Cartridge

One cartridge is included in the camera kit, but this is not enough.

Regular and two-capped cartridges of two kinds are currently available.

1. ***The metal two-capped cartridge*** is easily loaded, but before the installation, it is necessary to check whether the film can be pulled out smoothly. The film has to move relatively easily with force not exceeding 200 g. Sometimes the film can only be pulled applying considerable force which may cause scratches and perforation tear. In this case, remove the caps and widen the cartridge body slightly. To test a new cartridge, load it with the used film.

2. ***The plastic cartridge*** is sold preloaded with film. Before loading the camera remove the paper label (it makes the cartridge fit in the camera more easily) and slightly bend down the carved lock tooth *4* (see Fig.117). Never cut the inner spool head of the cartridge.

Metal two-capped and plastic cartridges may be used in any 35 mm camera.

Most Russian cameras are currently equipped with two-cylinder split cartridges. They are more convenient and reliable, but harder to load. Thus, photographers prefer not to use them.

The two-cylinder split cartridges open automatically after the back cover is locked, and the film advances easily, without touching the cartridge hole edges. This warrants easy film feeding and anti-scratch protection.

The slot edges in the regular cartridge are covered with velvet, and small particles may accumulate there, scratching the film. When the velvet wears out, light can penetrate the cartridge. This cannot happen in the two-cylinder cartridges.

A significant disadvantage of the two-cylinder split cartridges is that they are not standardized. The cartridges for "Kiev" and "Leningrad" cameras cannot be used with other cameras and vise versa. Besides, the cartridges for "Zenit-C", the "Zorki" line, and FED-2 cameras are not always interchangeable even though the design is identical.

When purchasing new two-cylinder split cartridges, check them carefully by loading them into the camera, putting the back cover in place, and shutting the locks. If the cover locks freely or with little force, and the film rewind knob 7 (Fig.241) rotates easily in both directions, the cartridge fits the camera. It is recommended not to replace the inner spools in the cartridges even if the cartridges are identical, especially in dealing with well-fitted cartridges.

Film on a spool is currently available. However, a spool does not always fit a cartridge. If a difficulty arises while loading the film, even if it is a minor one, the camera should be unloaded, and the spool replaced.

Camera Adjustment

Camera adjustment[*] consists of the adjustment of the body to the lens and of the rangefinder adjustment (if there is one). The body and lens adjustment and the rangefinder adjustment are two consecutive steps necessary to get a sharp image negative. At the same time, these are two entirely independent steps.

The body and lens adjustment means positioning the lens in such a way that the body working distance is equal to the lens working distance, and the emulsion surface of the film coincides with the focal plane.

The body working distance is the distance between the top plane of the lens mount ring and the support plate holding the film in the camera film track.

The lens working distance is the distance between the lower plane of the lens mount and the focal plane, i.e., a plane in the lens focus which is perpendicular to the major optical axis when the lens mount is set to infinity.

The diagram in Figure 4 shows the "Industar-10" lens. The straight line N-N_1 passing through the spherical centers is the major optical axis. The interval F-O is the focal length equal to 50 mm, i.e., the distance between the optical center and the focal point. The line F-M is the focal plane trace. The interval M-M_1 is the lens working distance.

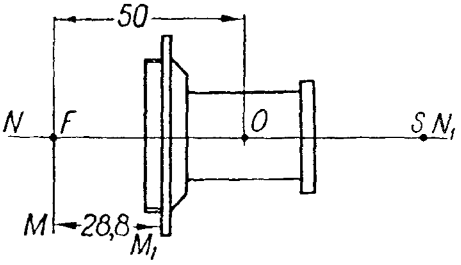

Figure 4. A diagram of the lens working distance.

The lens working distance is not arbitrary, but precise to the hundredths of a millimeter. All the lenses in cameras of the same type have the same lens working distance within minimal tolerance. For example, all modern 35 mm cameras with rangefinders (except "Kiev") are equipped with one of the following lenses: "Industar-50", "Jupiter-8" or "Industar-26M" with the same working distance of 28.8±0.02 mm. All the interchangeable optics have the same working distance. It is an important condition for installing any chosen lens.

Camera adjustment is necessary in the following cases:

1. A blurred negative as a result of camera shock.
2. After the body or lens had been disassembled for another type of repair.
3. New lens installation (for example, when the old "Industar-10" is replaced with the newer and faster "Jupiter-8").

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[*] Adjustment is a final step in the manufacturing (or repair) of precision instruments. A certain relative position of parts is identified to satisfy desired parameters: precision, sensitivity, resolution, etc.

Camera adjustment comes to positioning the lens in the body in a way that the best image would project on the surface of the light sensitive material perpendicular to the lens optical axis. (Concise Photographic Dictionary, "Iskusstvo", Moscow, 1956, p.381.)

As was already mentioned, first the body and lens are adjusted, and then the rangefinder adjustment is made. But this sequence is necessary only when the body and lens adjustment is needed.

Camera adjustment begins with the checking and adjustment of the rangefinder because the rangefinder adjustment is much more common than the lens and body adjustment.

Rangefinder checking and adjustment does not require the tools needed for the lens and body adjustment. Usually the rangefinder adjustment is sufficient for restoring normal negative sharpness. It applies to all three cases when adjustment is necessary.

After the rangefinder adjustment is completed, test the camera. If the test shows that the rangefinder adjustment did not help, check the body and lens adjustment. It follows that the rangefinder checking and adjustment is done first. But if the body and lens adjustment is necessary, it must be done first and the rangefinder adjustment next.

While servicing the camera, a specialist immediately checks and estimates the correct working distances of the body and the lens (the service facility has all the necessary instruments for doing this). This is important because all available interchangeable lenses have a standard working distance*.

If the adjustment of a camera without fully interchangeable optics is done by a non-specialist, the main lens working distance adjustment (if it is misadjusted) is omitted because it is very time-consuming and requires complete lens disassembly.

Adjustment of the body working distance is much simpler. It is done by lowering (less frequently) or lifting (more frequently), with the help of paper adjusting washers, the lens mount ring where the lens is screwed in.

According to the method of body and lens adjustments, all cameras fall into one of two groups: cameras without the removable back cover and cameras with the removable back cover.

Cameras of the first group are adjusted using special tools (see camera FED, p.131) or empirically. Cameras of the second group (cameras with lenses) are adjusted using a magnifying glass and a ground glass. This type of adjustment is much easier.

Details about the adjustment of cameras and groups of cameras are included in their descriptions.

MAJOR CAMERA ASSEMBLIES AND PARTS

Photographic Shutters

The shutter is one of the main units in a camera. There are two types of shutters: ***the leaf shutters*** and ***the focal plane shutters***. Each type, in turn, is subdivided into two groups depending on the design.

The leaf shutters may be of winding (semi-automatic) and non-winding (automatic) type.

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* Interchangeable lenses almost always require some adjustment of the rangefinder engagement part and, occasionally, working distance adjustment.

Winding shutters have two control levers: one is for winding the mechanism's working spring, and the other is for the shutter release (the "Moscow-2" camera is equipped with a "Moment" shutter of this type).

In non-winding shutters, the winding and the release of the shutter are both accomplished by a single lever's turn (for example, the "Fotocor-1" camera shutter).

The shutter working cycle (the time period from the beginning of the opening of the shutter blades to their complete closing) consists of three phases:

1. The time spent on opening the shutter.
2. The efficient time when the shutter is completely open.
3. The time spent on closing the shutter.

If the difference between the shape of the opening formed by the shutter's traveling segments (blades) and a circle is neglected, the shutter working cycle would look as shown in Fig.5. Light intensity on the light sensitive layer of the film will be changing along with the changing of the shutter opening size. In the beginning, the light intensity increases from the minimum to the maximum *a*, then for some time it is constant *b*, and finally it decreases to the minimum *c*.

Figure 6 shows a leaf shutter operation graph. Light intensity (S) vs. time of exposure (t) is plotted. The shutter working cycle is called ***the total shutter working time***, or ***the total exposure time*** (interval *AD*). The time of the complete shutter opening, when it allows maximum light to come in, is called ***the efficient time***, or ***the exposure time*** (interval *BC*).

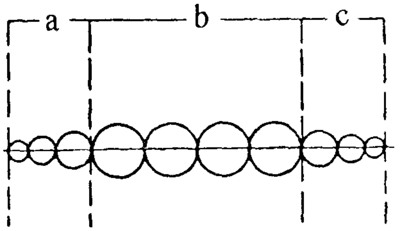


Figure 5. A diagram of the shutter working cycle.

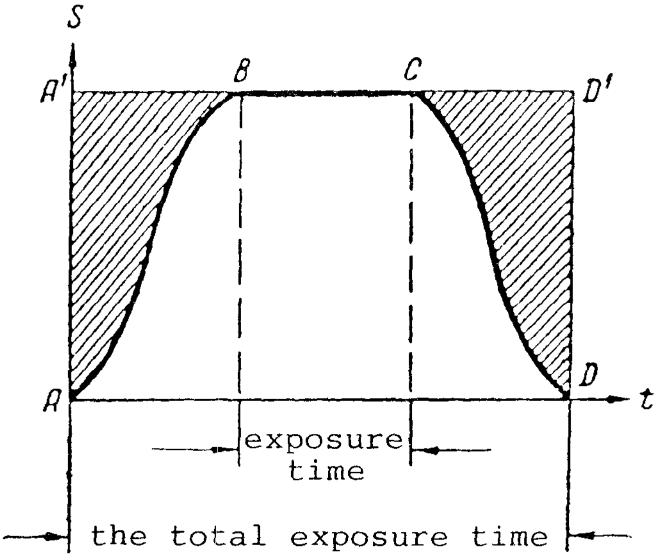


Figure 6. A shutter operation graph.

Area *ABCD* represents the amount of light entering through the shutter, and area *AA'D'D* represents the amount of light that would enter through the ideal shutter (an ideal shutter has the opening and closing times equal to zero).

The ratio of area *ABCD* to area *AA'D'D* is called an efficiency coefficient (EC).

Throughout the shutter operation, the opening and closing times are fairly constant while the exposure time is variable.Thus, the smaller the exposure time, the smaller the EC. When the exposure time is 1/250, the EC is less than for 1/100. EC for 1/100 exposure time is, in turn, less than for 1/50, etc.

In the focal plane shutters, the EC increases with a decrease in the distance between the curtain and the light sensitive layer of film; slit width increase and relative opening decrease equally increases the EC.

To improve the EC, the *ABCD* area has to be increased, e.g., the shutter blades' opening and closing times should be decreased. This can be achieved by adding, to the shutter mechanism, a working spring for speeding up the blades' movement and a delay mechanism for holding the blades open for a certain preset time.

The winding leaf shutters with a stronger working spring have a greater EC and wider exposure time ranges as compared to the non-winding shutters. Minimal exposure time of the winding shutters with 60-80% EC are 1/250 sec and 1/300 sec; minimal exposure time of the non-winding shutters with 50-55% EC does not exceed 1/100 sec. The delay mechanism also makes it possible to increase the exposure time up to 1 sec. That is why all the modern leaf shutters are of the winding type.

The leaf shutters are usually installed between the lens elements and are called interlensed. They operate as an interlens diaphragm, providing the even lighting of the entire frame surface. However, some cameras have leaf shutters behind the lens (for example, the "Smena" camera), so all the frame area lighting depends on the shutter blades' speed. The faster the shutter blades move during the shutter opening and closing, the lesser the difference in photographic densities between the corners and the center of the image. Therefore, only diaphragm interlens shutters can give the even lighting of the entire film frame area.

The focal plane shutters may have a slit of either constant, or changeable width. The slit of changeable width is formed by two flexible curtains (silk or metal) which wind from one cylinder to another and form a slit of preset width.

To increase the EC and exposure times, the range focal plane shutters are installed immediately next to the film plane. The large exposure time range is achieved by fast curtain movement and changeable slit width.

In the leaf shutters with 60-80% EC minimal exposure times do not exceed 1/300 sec, while in the focal plane shutters with over 95% EC minimal exposure times reach 1/1000 and 1/1250 sec (as in the "Kiev" camera).

One of the focal plane shutters' features is the fact that in the shutter operation, the slit moves along or across the frame (depending on the shutter design), exposing the fixed film. The slit width changes, with every exposure time, from 40 mm for 1/25 sec to 3 mm for 1/500 sec (in the FED camera).

The slit cannot move along the frame window instantly. It takes some time. The curtains' speed increases toward the end when they have overcome the mechanism's inertia. As a result, the film exposure is not uniform.That is why changing of the moving slit width was designed (the slit is narrower at the beginning and wider at the end of the frame window). Besides, the frame is so small that if the curtain's speed is significant and the mechanism is adjusted correctly, the ununiformity of the exposure has barely any effect. The frame area is exposed ununiformly if the shutter mechanism is malfunctioning. This can be fixed by the adjustment of the curtains' tension springs and by cleaning (lubricating) the mechanism (see p.38).

The shutter malfunctions at low temperatures (except for in cameras with metal curtains that are specially lubricated) and when the curtains are damaged or lose elasticity of their rubber coating.

After defining the "exposure time" or “efficient time" of the shutter some new terms have to be introduced: the "shutter speed mechanism knob", the "auxiliary shutter speed mechanism", the "exposure time setting mechanism", etc.

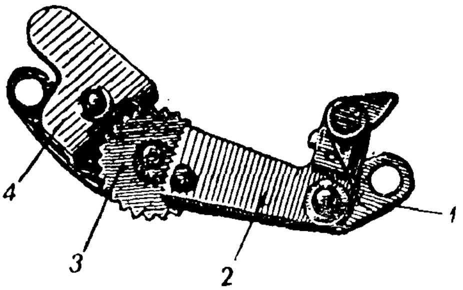


Figure 7. The simplest delay mechanism.

Figure 7. The simplest delay mechanism.

Delay Mechanisms

Most cameras have a delay mechanism similar to a watch mechanism with a set of gears and a pallet fork. Its gears are driven by a spring (tape or spiral) placed either inside, or outside the mechanism. Free gear movement is slowed down by a pallet. Thus, the mechanism is called a delay mechanism. There are also self timer mechanisms which are a more complicated version of a delay mechanism.

The simplest delay mechanism installed in the shutter of the "Lubitel" camera consists of the base *1* (Fig.7) and gear sector *2*, the escape wheel *3*, and the pallet *4* located on it. The turning gear sector *2* rotates the wheel *3* slowed down by the pallet *4*.

In all cameras, long exposure times (1 sec, 1/2 sec, 1/5 sec, 1/8 sec, 1/10 sec) are controlled by delay mechanisms.

Some types of cameras are equipped with two or even three delay mechanisms of different designs, but all are based on the same operational principle.

Rangefinders

Sharpness of the image on a negative is achieved not only by the high quality of the camera and the lens, but also by precise focusing (lens focusing).

In simple cameras, focusing is accomplished by viewing the sharpness of the image on the ground glass (for example, the "Fotocor No.1" camera) or by a range scale on the camera mount. However, rangefinders are the most precise focusing devices.

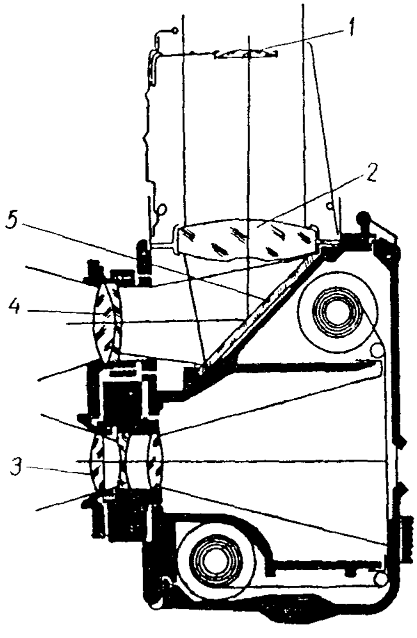


Figure 8. An optical diagram of a twin lens reflex camera.

The rangefinder is an optical instrument for determining the precise distance to an object. Cameras with built-in rangefinders are the most common. Sometimes, rangefinders are separate instruments. The best rangefinders in modern cameras are monocular ones for one-eye viewing.

There are two types of rangefinders: the one with the ground glass and the basis type.

Rangefinders with the ground glass are installed in single or twin lens reflex cameras. In a twin lens reflex camera, the function of the rangefinder is fulfilled by an almost complete second camera. Figure 8 shows an optical diagram of a twin lens reflex camera with equal focal lengths of the rangefinder lens *4* and the camera lens *3* which provide good focusing. Both lenses move simultaneously. The image of a subject is reflected by the mirror *5* on the ground surface of the collective lens *2* (or the ground glass) and is viewed through the magnifying glass *1*.

Here are some disadvantages of this camera: it does not have interchangeable optics, and the diaphragm in its rangefinder lens does not allow to determine the depth of field.

In a single lens reflex camera focusing, viewfinding, and photographing are done by one and the same lens. Figure 53 shows an optical diagram of a single lens reflex camera. The advantages of this camera are the option of using interchangeable optics, the visible diaphragm effect on the depth of the field, and the absence of parallax. This type of camera has the following disadvantages: one has to open the diaphragm while aiming at the subject, and prior to shooting, one must determine the relative lens opening.

Currently available higher class cameras (such as "Start") have a "release diaphragm", which is a device allowing a full diaphragm view of the subject until the moment of the shooting. When the shutter release button is pressed, the diaphragm opening is set to a predetermined value.

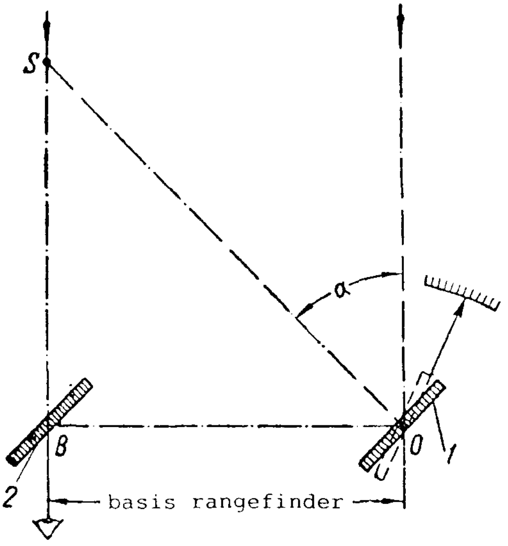


Figure 9. A diagram of a basis rangefinder.

Most 35 mm cameras are equipped with ***the basis rangefinder***.

Although the designs vary, the operational principle of all basis rangefinders is changing the parallax angle. Figure 9 shows a diagram of a basis rangefinder. A subject located at point S is viewed through a semi-transparent glass *2* set at a 45° angle with respect to the eye. The mirror *1*, facing the subject, turns around the O axis. Therefore, two subject images can be viewed: one is the real one behind the semi-transparent mirror *2*, while the other is imaginary, i.e., a reflection in the mirrors *1* and *2*. The mirror *1* is rotated slowly until both images coincide. The closer the subject, the larger the mirror *1* rotation angle for overlaying the images will be.

If an arrow is affixed to the mirror *1*, its shift will indicate on a meter scale the exact distance to a viewed subject. The distance BO is called a rangefinder basis, and the angle α is called a parallax angle. The larger the rangefinder basis, the higher the accuracy of the rangefinder will be.

The FED and "Zorki" cameras have the three-faceted prism *5* (see Fig.157) in place of the moving mirror; in the "Moscow" cameras (except "Moscow-1" and "Moscow-3") both mirrors are fixed, and beams are deflected by the optical wedge compensator *4* (see Fig.29a) consisting of two optical wedges rotated in opposite directions and forming a three-faceted prism; in the "Kiev" cameras, the compensator (see Fig.341) consists of one planoconvex *1* and one planoconcave *2* lens element, and refraction change is achieved by rotating one of them. All basis rangefinders are mechanically coupled to the lens mount.

Every basis rangefinder can be vertically and horizontally adjusted. In every rangefinder, regardless of the design, one subject image is fixed and the other (imaginary) is shifted until it converges with the first image.

In the rangefinder (Fig.10), the traveling image has to move on one level with the fixed image. If the traveling image is lower or higher than the fixed one, the malfunction is called a vertical misadjustment (Fig.10a).

When the horizontal adjustment is off (Fig.10b), the distance indicated on the lens scale does not agree with the real distance, and/or the traveling image of the infinitely distant subject is captured either before or after the fixed image. Let us consider a subject 4 m away. Both images (fixed and traveling) in the rangefinder coincided, and the lens meter scale indicates not 4 m, but more. It means that the horizontal adjustment is off.

The basis rangefinder misadjustment is the most common camera malfunction.

While focusing the camera, a photographer usually notices that the vertical adjustment is off because one image is seen above the other. Such non-coinciding images do not always result in horizontal misadjustment and blurred pictures; it is just unpleasant to the eye. Horizontal misadjustment of the rangefinder distorts the distance causing blurred negatives. It cannot be noticed without checking the lens meter scale.

To check the rangefinder operation, point the camera toward an infinitely distant object (an antenna mast or a tower over 100 m away).

A rangefinder consists of several optical parts (prism, lens, mirror) affixed by shellac glue or a spring. It also has many levers and adjusting screws. Falling and shaking of the camera in the car trunk, on a motorcycle, etc. can cause a misadjustment of the rangefinder.

Most often the rangefinder is damaged by incorrect screwing of the lens into the body. Many amateur photographers do not have a special lens for an enlarger, so they use the camera

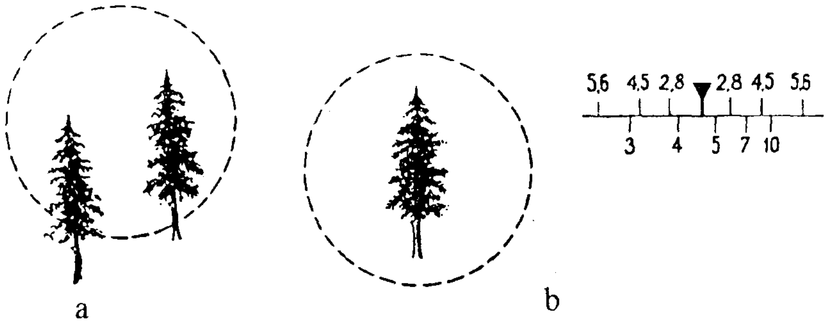


Figure 10. The rangefinder adjustment:
a - vertical adjustment is off; b - horizontal adjustment is off.

lens instead. Taking the camera lens out and especially using it in the enlarger is discouraged. If it is absolutely unavoidable, the lens has to be unscrewed and, most importantly, screwed back in correctly.

A camera mount consists of two parts: one is fixed in the camera and the other turns on the multi-entry thread. When the mount is rotated toward an infinity (∞) sign, the lens goes down, and the turnable mount part's butt-end pressing against the cam goes down as well. If the mount is rotated toward the 1 m index so that the mount lever shifts to the thrust screw ("Industar-10", "Industar-22", "Industar-50" lenses) or stops inside the mount ("Jupiter-8", "Industar-26M", "Industar-50" in the fixed mount lenses), the mount's butt-end goes up and levels with the fixed part of the mount.

The lens is screwed in and out of the camera when the lever is shifted to the thrust screw and the butt-end is leveled. If the lens is screwed in when the mount's butt-end protrudes, it immediately hits the cam *12* (see Fig.127) of the rangefinder and deforms the cam lever. The lens has to be screwed in completely, but it must not be overtightened.

Optical wedge. One of the basis rangefinder parts is an optical wedge or a wedged compensator which serves for regulating the rangefinder vertical adjustment.

Light rays can be diverted from a straight path by two methods: reflection and refraction.

Figure 11a,b shows schematically the refraction of the light rays when the light passes through a glass plate with parallel facets and through a prism. In the first case, the light rays exit the glass at the entrance angle with some side shift; in the second case, as a result of the double refraction, the light rays exit at a different angle.

An optical wedge (Fig.11b) is a prism with a small refraction angle. Passing through the optical wedge, light rays are deflected toward the base, i.e., toward its thicker end. It allows rangefinder adjustment within the refraction capacity of the optical wedge -- the refraction angle and the optical wedge glass refraction coefficient. To familiarize yourself with the principle of its operation, turn the optical wedge (round in shape) in the FED camera and observe a subject through it.

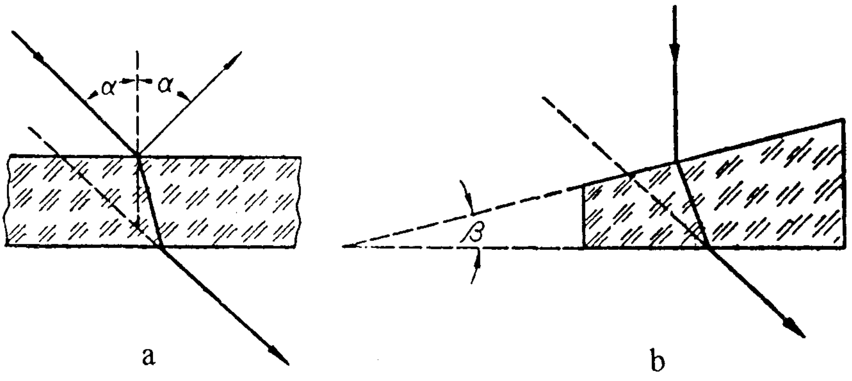


Figure 11. A diagram of the light rays passing through glass:
a - parallel-faceted ; b - through a prism

Modern single lens reflex cameras (for example, the "Start" and "Salut" cameras) are also equipped with optical wedge focusing devices.

Optical mirror. Regular mirrors are made of well-polished glass with a thin metallic layer on the back. They are called mirrors with back coating.

In optical mirrors, the reflecting metallic layer is applied onto the surface facing the light. In the regular mirror, the light beam passes through the glass, and it is then reflected by the metallic layer; in optics, when an ideal image is required, the light beam is reflected by the front surface of the glass.

Optical mirrors are coated with pure aluminum by vacuum evaporation. These mirrors do not fade for many years. Viewfinder-rangefinder mirrors of all single lens reflex cameras are made this way.

Moisture and incorrect cleaning cause damage to the mirrors. ***Mirrors must not be wiped***. Dust can be removed from them by an air flow.

All basis rangefinders have semi-transparent mirrors (the FED, "Zorki-C", "Zorki-2C" cameras) and semi-transparent layers coated with a layer of gold or some other metal applied on the prism adhesive joint (in "Zorki-3", "Zorki-4", FED-2, "Kiev", etc.).

Viewfinders

All cameras without exception are equipped with viewfinders which help determine shot limits and the composition of the shot. There are frame viewfinders and optical viewfinders. All modern cameras, except "Lubitel", have optical viewfinders. "Lubitel" has two viewfinders: optical and frame. There are mirror, telescopic, mirror-telescopic, and universal-telescopic viewfinders.

The mirror viewfinder design is described on p.22.

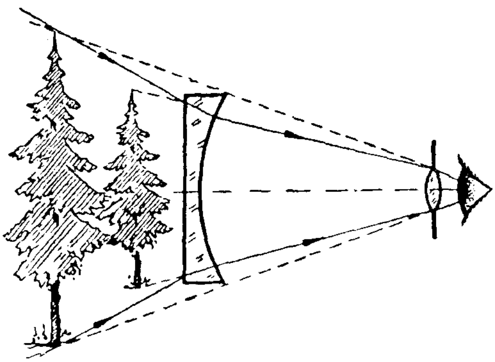


Figure 12. A telescopic viewfinder.

Most cameras are equipped with telescopic viewfinders - collapsible (the "Moscow-2" camera) or rigid ("Smena", FED, "Zorki", etc.). The telescopic viewfinder (Fig.12) consists of two lens elements: the front is negative and the back is positive. Bundles of light rays entering the viewfinder lens have different axis tilts. Passing through the front dispersing lens element, they change their direction and are seen in the viewfinder eyepiece as having a smaller axis tilt; this is the reason why the viewed subject seems to decrease in size. The viewfinder can be made smaller using image reduction. This is important for fitting it into a 35 mm or miniature camera, and for maximal approximation of its optics axis to the lens axis.

The telescopic viewfinder is usually located in the upper part of the camera, i.e., above the lens. The lens optics axis and the viewfinder optics axis do not coincide. Therefore, the shot and the view sizes do not coincide either. This non-alignment of borders is called parallax and is not a camera malfunction.

View borders may shift in far object photography. However, if the shift does not exceed 5 cm, the parallax can be regarded as insignificant. In close object photography, the parallax has to be considered. The closer the object, the more correction is required. The correction is made as follows. If the camera is aligned horizontally, the viewfinder is pointed a little above the object; if the alignment is vertical, the viewfinder is pointed a little to the left of the object.

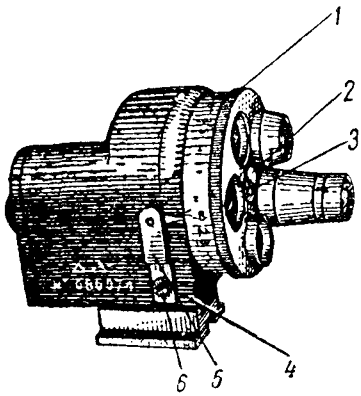


Figure 13. The universal viewfinder.

The single lens reflex cameras (cameras with the mirror viewfinder, in which the camera and the viewfinder share a common lens) do not require a parallax correction. The mirror viewfinder does not produce straight images. Instead, it produces images that are inversed from right to left. The telescopic viewfinder produces straight congruent images. The twin lens reflex cameras require the same correction as cameras with telescopic viewfinders.

There will be no parallax if the viewfinder can be tilted as the camera approaches the subject. Some cinematographic cameras, such as "Tourist", have viewfinders of this design. They are not used in photo cameras because they would increase camera size and complicate the design. To avoid parallax error, the frame of the viewfinder is usually made somewhat smaller than the image size on the picture.

It is recommended to check the parallax of the camera empirically. To do that, the camera has to be set on a tripod, and the view borders in the viewfinder must be checked against the actual view on the picture.

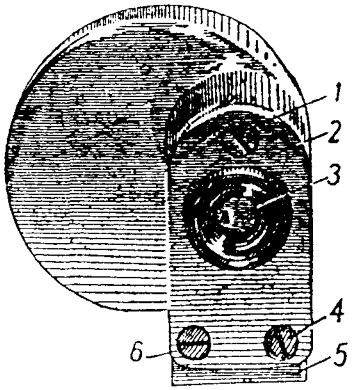


Figure 14. The back view of the viewfinder.

Many cameras have telescopic viewfinders combined with rangefinders (FED-2, "Zorki-4", "Zorki-5", "Kiev", etc.) so view finding and focusing are done simultaneously.

Universal viewfinder "UV" (Fig.13) usually eliminates the parallax error at all distances from 1 m to ∞. It can be installed on any 35 mm camera. It is mostly used as a universal viewfinder for interchangeable lenses with the focal length 28, 35, 50, 85, and 135 mm. Elimination of the parallax error and clear view make the "UV" (Fig.13) useful for the camera's main lens. The deflecting prism straightens and sufficiently enlarges the image.

The viewfinder is installed on the camera accessory shoe with the aid of a T-shaped base.

Since any 35 mm camera can be equipped with a "UV", let us study its design and repair in greater detail.

The major exterior parts of the "UV" are the turret *1* (Fig.13), the turret screw *2*, the locking screw *3*, the body *4*, the fastener spring *5*, the fastener screw *6*, the panel screws *1*, *4*, and *6* (Fig.14), the panel *2*, the eyepiece *3*, and the base *5*. During "UV" operation, dirt accumulates on optical parts and clouds the object view.

To clean the viewfinder, it is necessary to know its design and disassemby sequence. The design is not complicated, but it is important to keep in mind that, like any optical instrument, the "UV" requires gentle handling during its disassembly, especially the two prisms.

Five lenses whose focal lengths are proportionate to those of the camera lenses are installed on the turret *1* (Fig.13). The turret rotates on the shaft. It is fastened by the screw *2* with the locking screw *3*. Therefore, as a first step, the locking screw *3* has to be removed, then the screw *2*, and finally the turret with the lenses.

The lens element *1* (Fig.15) is fixed inside the body. There are two prisms on the back of the body. If the screws *1*, *4*, and *6* (Fig.14) are unscrewed, and the panel *2* with the eyepiece *3* is removed, the prism *2* (Fig.16) and the cylindrical split spring *1* become visible. The prisms and the panel are not fastened, so they will come out as soon as the panel *2* (Fig.14) is removed. Therefore, the panel should be removed when the "UV" is in such a position that the prisms cannot fall off. Before removing the prisms and the spring, memorize their proper positions, prism *1* (Fig.17), in particular. The prism *2* position (Fig.16) is easy to remember if you pay attention to the orientation of its acute angle. Tilt the viewfinder body slightly, hold the prism by the side, and remove it. Then take out the prism *1* (Fig.17). Now the back of the lens element *1* (see Fig.15) becomes accessible as well as all the other optical surfaces: lenses on the turret, the lens element, and both prisms (see p.31).

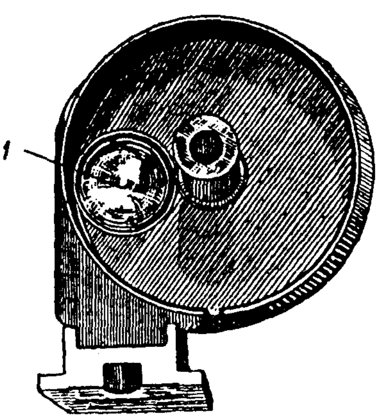


Figure 15. The viewfinder lens element.

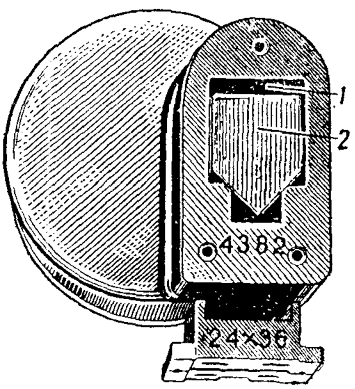


Figure 16. The viewfinder outer prism.

The "UV" is assembled in the reverse order. Before reinstalling the turret, clean all the grooves that hold the fastener spring protrusion (see Fig.13). When a groove is dirty, the spring fastens the turret poorly. The spring can also be bent to make it more resilient.

Flash Synchronization Mechanisms

The flash synchronization mechanism is a device for switching on the flash synchronized with the shutter operation.

There are two types of flashes: disposable bulbs and pulsed flashes. The duration of the flash of the disposable bulb is about 1/25 sec. The moment of the maximum radiation is delayed by 1/50 sec after the electric circuit (burning inertia). Therefore, the electric circuit of the flash has to be closed some time before complete shutter opening. This time period is called ***the forestall time***.

The pulsed (electronic) flashes are switched on immediately and have a flash duration of about 1/200 sec. Thus, the electric circuit of the flash has to be closed at the time of complete shutter opening. The forestall time is not required in this case.

Different flash synchronization mechanism designs reflect different features of the flashes and the shutters. Depending on the type of the flash synchronization mechanism , all cameras fall in one of three groups.

The first group. Cameras equipped with leaf shutters which have one flash socket and one pair of contacts. The latter close circuit at the moment of complete shutter opening.

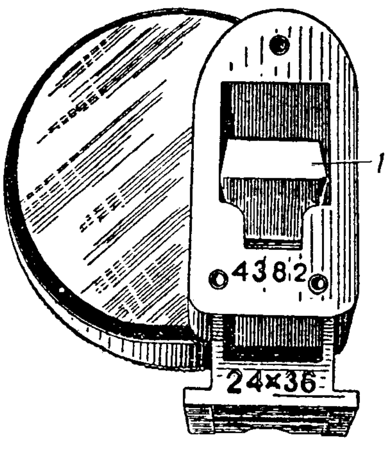


Figure 17. The viewfinder inner prism.

"Lubitel-2", "Moscow-4", "Moscow-5", "Smena-2", "Smena-3", etc. belong to this group. Leaf shutter blades open completely at all exposure times. Thus, leaf shutters can be used with the pulsed flash at all exposure times. Disposable bulbs can be used at the exposure times of 1/10 sec and longer. This group also includes the cameras with the focal plane shutters (for example, FED-2 and "Kiev") where pulsed flashes are used at the exposure times of 1/25 sec and longer (at these exposure times the size of the curtain slit is no less than the frame window size).

The flash synchronization mechanism in the cameras of this group is also called a flash synchronization mechanism with zero contact, i.e., circuit closing occurs at the moment of complete shutter opening.

The second group. Cameras with two flash sockets and two pairs of contacts. One flash socket is connected with the pair of the contacts which close the circuit before complete shutter opening (forestalled); the second flash socket is connected with the second pair of the contacts that close the circuit at the moment of complete shutter opening (zero contact). The pulsed flash can be used at the exposure times of 1/25 sec and longer.

This group includes "Zorki-5", "Start", etc.

The third group: Cameras with one flash socket and a synchroregulator. The synchroregulator is a mechanism that closes the circuit on the zero contact and forestall time contact by shifting the traveling contacts. The forestall time is set in accordance with the flash characteristics indicated in its specifications. The synchroregulator (see Fig.167) has a time scale calibrated from 0 to 25 msec. In the pulsed flash operation, the synchroregulator lever is set to zero.

This group includes all cameras of the "Zorki" line, "Zenit" cameras, etc.

There is a lever or some other part serving as a circuit switch in every camera or shutter. At shutter actuation it turns at a certain angle. Some examples are the slotted guide plate *5* (see Fig.47b) in the "Moment" shutter or the exposure wheel *7* (see Fig.168) in the "Zorki-C" camera.

Remember that ***in all cameras*** the flash synchronization mechanism's electric circuit has only one insulated contact; the circuit closing goes through the camera body. Plug in or unplug the flash in one motion, perpendicular to the camera accessory shoe. Turning the plug in different directions is discouraged since the accessory shoe is fastened with a nut. Flash synchronization malfunctions are less common than those of the pulsed flash. Therefore, if the pulsed flash would not switch on, check it and its connecting cord, paying particular attention to the insulation cord in the place of the connection. Whether or not the flash is functioning can easily be ascertained by connecting it to another checked camera.

It is possible to build a simple controlling device. A millivoltmeter and a flashlight battery are needed for this. The camera flash synchronization mechanism is connected through a series electric circuit with the voltmeter and the battery. If the meter needle is deflected, the flash synchronization mechanism is in working order.

Interlocking Devices

Interlocking devices are the automatic mechanisms blocking the operation of one or many mechanism parts. In cameras different interlocking devices are widely used. For example, an interlocking device could block repetitive photographing on the same frame.

Let us consider the interlocking device in the "Moscow-2" camera. The shutter release lever *12* (see Fig.36a) will not turn until the shutter is wound. The release button *12* (see Fig.29a) cannot be depressed or shifted until the film is advanced to the next frame. Thus, until the film is advanced to the next frame and the shutter is wound, the release cannot be done.

In the single lens reflex cameras, the shutter will not operate until the mirror of the viewfinder-rangefinder is returned to its original state.

In most cameras, all major units are interlocked.

PHOTOGRAPHIC LENS

Lens Design

The modern photographic lens is a complex optical device which in many ways defines how the camera can be used and the quality of the photography.

Every lens consists of a set of lens elements and a mount. The number of lens elements in the set may vary. They may be cemented together or separated by air spaces. The type of the mount depends on the camera design.

Most lenses consist of two parts: one is a mount-block (Fig.18) holding all optical parts and the diaphragm; the other is a transitional mount for axial shifting of the mount-block and for connection with the camera. The transitional (exterior) mount consists of a few ring-shaped parts connected by one or more multi-entry threads. Rotation of one ring causes an axial shift in the part of the mount where the lens block is mounted. The use of mount-blocks makes the lens assembly and adjustment independent of any further final fitting of the lens to the camera. There is a difference between the block adjustment, i.e., mounting of the lens elements in it, and the adjustment of the exterior mount with the mount-block. Adjustment of the optical parts in the mount block can only be done at a manufacturing site with the aid of the appropriate optical instruments. An amateur cannot do it himself, and it is not necessary.

The working distance of every lens (see p.18) is adjusted by elevating or lowering the mount-block in the exterior mount. Therefore, lens adjustment done outside the manufacturing site and described in this book must be accomplished by the correct and precise setting of the mount-block with respect to the body.

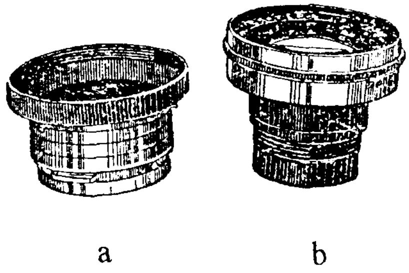


Figure 18. The major parts of the lens:
a - the exterior mount; b - the mount-block.

There are different kinds of mounts. In the cameras without interchangeable optics the lens is fixed. This type includes the "Smena", "Moscow", "Lubitel", "Iskra", and "Unost" camera brands.

The fixed lenses are installed in the leaf shutter mounts. There are three kinds of them:

a) one with the thread on the outer surface of the mount-block so that the block can be screwed into the shutter body (for example, the "Smena" brand);

b) one with the thread on the outer surface of the front lens element mount. The rotation of this element mount focuses the lens. Mounts with the rest of the lens elements are fixed (for example, the "Moscow" and "Lubitel" brands);

c) one with the mount-block and the exterior mount designed similarly to the lenses in cameras with interchangeable optics; the only difference is that the exterior mount is fixed on the camera body (for example, the "Iskra" and "Unost" cameras).

In cameras with interchangeable optics, all the lenses have the mount-block and the exterior mount. Exterior mounts are designed in a way that the lens can be replaced easily and quickly.

Depending on the connection of the lens to the camera body, there are three kinds of mounts: 1. one with the thread for non-reflex cameras of the "FED", "Zorki", "Droog", "Leningrad" types; 2. one with the thread for the single lens reflex cameras of the "Zenit" and "Crystal" types; 3. the bayonet mount for the cameras of the "Kiev" and "Start" types. The most convenient mount for fast lens replacement is the bayonet mount.

Lens Handling and Cleaning

The optical surfaces and the lens mount must be clean at all times. The camera lens should be covered with a cap or a filter. Do not touch the lens surfaces because this may cause damage to the glass coating. The lenses should be stored at room temperature.

The cleaning procedure for all types of lenses is the same. However, even the most skillful cleaning leaves marks on the lens surfaces (especially on the coated lenses). Thus, they should be cleaned very rarely. Besides, lens cleaning does not necessarily mean its wiping and washing. If there are no fingerprints or oily spots on the lens optical surface (oily spots can be caused by leaks from the lubricated diaphragm and the mount parts), simple dusting is sufficient. Such dusting is accomplished by blowing air from a rubber bulb, or with a weasel brush. A few dust particles on the lens surface are insignificant and do not require lens cleaning.

Oil vapors and fingerprints are removed by wiping with a piece of hygroscopic cotton moistened in 90% petroleum ether and 10% alcohol mixture or 100% alcohol if the ether is unavailable. Acid and salt solutions cannot be used. Before washing the lens, remove the dust by blowing air; hard particles scratch the lens surface. Wrap a piece of cotton tightly around a thin wooden stick (do not touch the cotton so as not to get it dirty). Wipe the lens with light circular movements from the center to the edge. The procedure should be repeated several times, changing the cotton each time. Make sure not to overmoisten the cotton because liquid leaves stains underneath the lens; to remove them would require disassembling the lens. Do not wipe the lens elements with a handkerchief, piece of cloth or suede because the dust that accumulates on them may scratch the lens surface. The brush and the cotton used to clean the lens should be wrapped in rice-paper and kept in a glass jar with a closed lid.

It is usually enough to clean just the front and the back lens elements. Complete lens disassembly should be avoided unless absolutely necessary.

When disassembling the lens completely, memorize the positions of the lens elements by their shapes (Fig.19).

While cleaning the lens, do not forget about the 0.1 micron coating of all the lens surfaces. The coating is applied in order to reduce harmful light reflections inside the lens. In addition, coating increases the image contrast and improves the color rendition in color photography. Thus, the coating requires especially gentle handling. Keep in mind that if oily spots remain on the len surface for a long time they decompose the coating, leaving permanent marks.

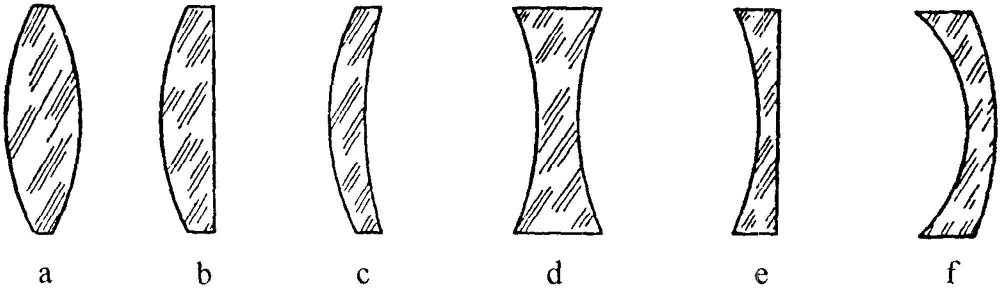


Figure 19. Lens shapes.
Collective: a - bi-convex; b - plano-convex; c - concavo-convex. Diffusive: d - bi-concave; e - plano-concave; f - convexo-concave.

Diaphragms

All lenses, except the "Industar-M" lens of the "Kiev-Vega" camera, are equipped with an iris diaphragm located in the middle part of the mount-block between the front and the back components. With the aid of the diaphragm, an aperture is changed without distorting its round shape.

The diaphragm (Fig.20) consists of blades (their number varies), base, crown, and exterior tang connected with the crown.

Every blade (Fig.20c) has, on its sides, two pins pointing in opposite directions and serving for the blade rotation. The lower pins of the blades enter the holes in the fixed diaphragm base (Fig.20a). A traveling spline crown (Fig.20b) with either through or non-through splines is positioned above the blades. The upper pins of the blades enter the crown splines. When the crown is rotated, the blades turn with it (Fig.21), and the diameter of the opening changes.

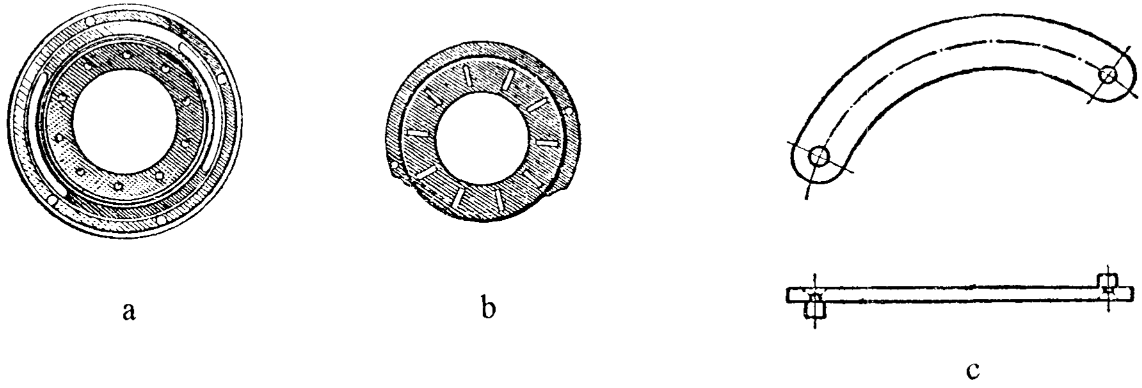


Figure 20. Major diaphragm parts:
a - major; b - spline crown; c - blades.

The crown is connected with the exterior diaphragm tang or with the lever by one or two screws.

The operation principle is the same for all diaphragms; design features and repair are described in chapters dedicated to a particular camera or lens.

Assembly is the same for all diaphragms. The base of the diaphragm has a number of holes equal to the number of blades in the diaphragm. Let us consider a diaphragm with ten blades. The first seven blades are easy to install because the holes in the base are visible; the last (seventh) blade blocks access to the remaining three holes (the blade is much longer than the distance between the holes). Thus, it is harder to install the rest of the blades. Hold the installed blades with your left hand to keep them in place; move the eighth blade gently with your right hand until its pin finds the hole, etc. When all the blades are in place (they should be in the "open" position), install the spline crown to set all the upper pins into the crown holes. The crown is fastened with a spring gasket or with screws.

In some lenses the diaphragm base along with the entire diaphragm can be taken out of the lens block.

When exactly is diaphragm disassembly necessary? Usually the diaphragm has to be disassembled because the lubricant is too thick, and it is hard to turn the blades. This results in the deformation and dislocation of the pins. The blades must be covered with a very thin layer of oil. Too much oil is bad because its vapors condense on the lenses. Some oil can be removed from the diaphragm without its disassembly. To do that, wipe the blades several times with light circular movements using a compressed piece of cotton moistened in benzine. Turn them several times after every round.

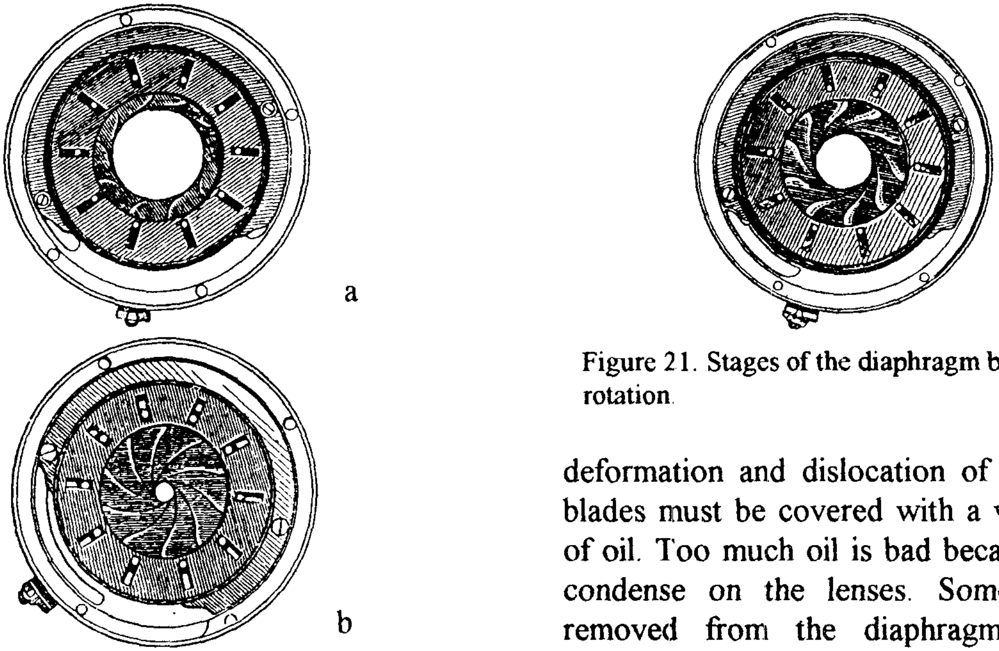


Figure 21. Stages of the diaphragm blade rotation.

If a pin has fallen off the blade (this is indicated by a distorted diaphragm opening), it has to be replaced. A new pin can be made out of copper wire with the aid of a portable jeweler's vice or a machine-tool with a diameter equal to that of the old pin. The wire is held by the vice so that the end of it sticks out about 1 mm. With the help of a small file, the end is shaped to fit the blade hole which is smaller than the pin's diameter. The new pin is then cut off with a fretsaw and placed on a hard metal surface. Holding a blade in your left hand, set it on top of the pin and rivet its end with a small hammer. Do not file the pins on the blade because they may come off. That is why, prior to putting them in, it is so important to make sure that the pins are of the exact size.

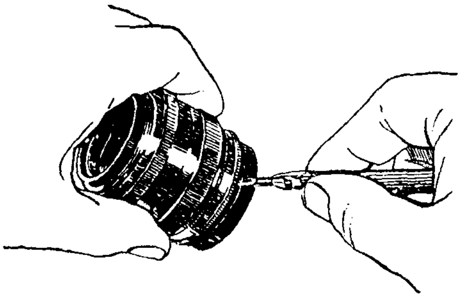


Figure 22. Removing a stuck filter.

Filters

Filters are the optical accessories of the camera.

In some types of cameras the filters are installed on a thread cut in a lens mount and on the filter rim (0.5 mm pitch). Since a filter diameter is relatively large, the lack of alignment results in stuck threads. Thus, it has to be screwed in carefully. Slightly turn it to the left (counter-clockwise) to align thread entries and slowly screw it in.

When the camera falls, the filter often gets stuck and cannot be unscrewed. In this case it is necessary to insert a screwdriver between the lens mount edge and the filter rim (where the clearance is the least) and lift the filter by exerting slight pressure (Fig.22). This usually makes it possible to elevate the lowered edge of the filter rim and realign the threads. After that the filter can be unscrewed. If it does not yield, make two slots in the opposite sides of the rim's upper part, with a handsaw or a thin file, insert a thin steel plate in them, and unscrew the filter with your right hand while holding the lens in the left hand.

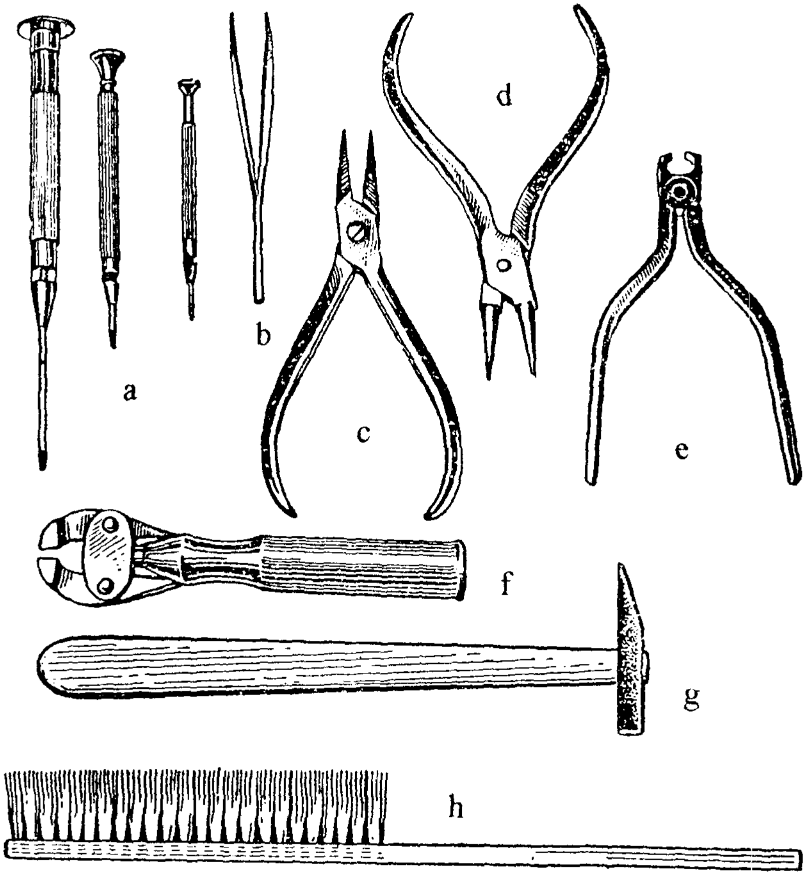


Figure 23. Tools:
a - screwdriver set; b - tweezers; c - pliers; d - round pliers; e - sidecutters; f - portable jewelers' vice;
g - hammer; h - brush.

In some lenses, such as the "Jupiter-3", "Jupiter-9", the block of the lens elements is not fastened (is not fixed by a locking screw) in an exterior mount, but is just tightly screwed in. The entire lens block with the diaphragm can be unscrewed when force is applied to remove the filter. If this happens, screw the block back in to the limit so as to align the "completely open diaphragm" index with the red line or dot on the mount. Do not overtighten the filter.

PREPARATION AND EXECUTION OF REPAIR WORK

Tools

Watch repair tools are used for most of camera repairs (Fig.23).

In photo equipment, fastening screws of different sizes are used: M1.7x0.35, M1.2x0.25, M1.4x0.25, and M2x0.4. The screwdriver set should correspond to these screw sizes, and the screwdriver's blade should either correspond to the screw's slot or should be somewhat thinner. If an inappropriate screwdriver is used, the screw or the camera's plating and finish may be damaged. The screwdriver's blade should be inserted properly.

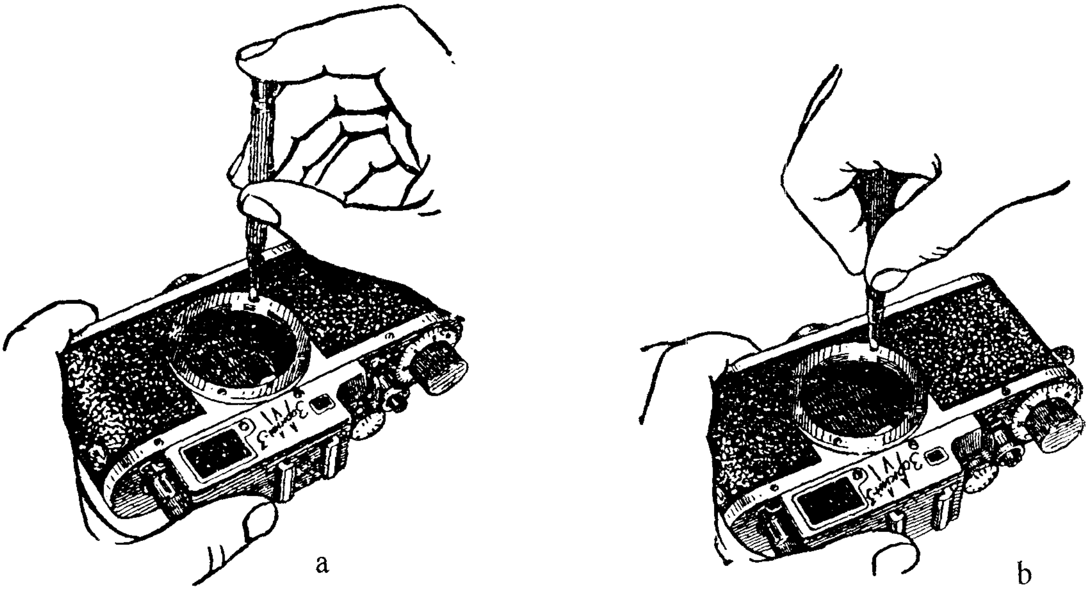


Figure 24. Unscrewing the screws:
a - correct screwdriver position; b - screwdriver position when a screw is too tight.

Hold the screwdriver in such a way (Fig.24a) that its blade would not slip out of the slot. If a screw is too tight, hold the screwdriver as shown on Figure 24b.

Special tools are required for repair of some camera brands; their descriptions and manufacturing can be found in other chapters of this book.

Disassembly and assembly of different camera units or lens units is done with the aid of keys (Fig.25) made of hard metal, preferably of 1.5-2 mm steel.

It is difficult to find a universal key shape for the repair of different cameras and lenses. The necessary key shape depends on the size and shape of the part being unscrewed and its location. A key has to have a convenient handle. If the handle is small, it is held with pliers. It is possible to use a long rounded handle with an incision (Fig.26a, b) made with a handsaw, so that a key of any shape can be inserted in it.

Almost all camera and lens parts with a thread have special openings for positioning a tool. Do not use tweezers, pliers, and similar tools for unscrewing parts because they may scratch a lens, chromium coating, or can damage the tool engagement openings.

If some part cannot be unscrewed, oil the joint and try again in a few hours.

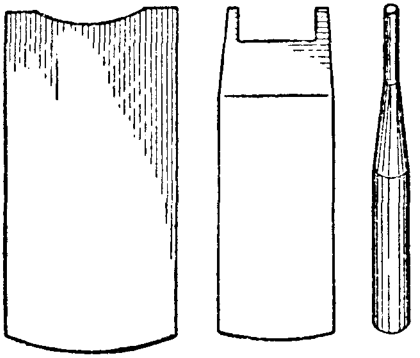


Figure 25. Key shapes.

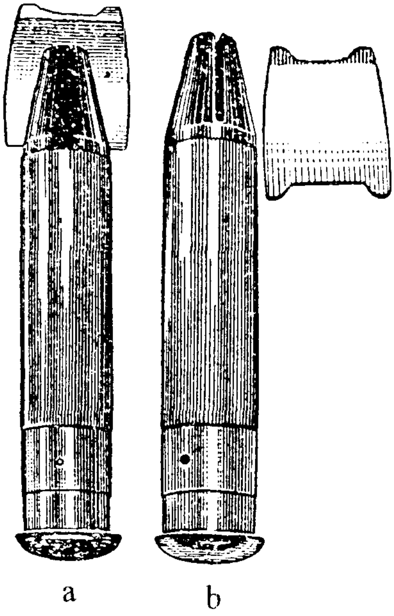


Figure 26. Handle:
a - with a key; b - without a key

In some cameras, nitrolacquer is injected in the lens mount thread joints. To disassemble this mount, the nitrolacquer has to be dissolved in acetone by injection in the joint. Lubricant and acetone should be used in small quantities so they do not contaminate the lenses or the diaphragm.

Almost all 35 mm cameras and some medium format cameras (for example, "Moscow-5") have round eyepieces and front protective glasses 8 (see Fig.48). Unscrewing these requires great care and skill. Eyepieces are screwed on a thread which becomes dirty and oxidized after a while. They should be unscrewed with great caution so that the glass does not break, and the eyepiece and protective coating remain intact (Fig.27).

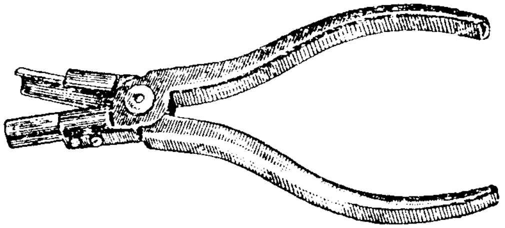


Figure 27. Pliers for unscrewing eyepieces (cupropliers).

Special pliers with copper semi-rounded jaws (cupropliers) are used for unscrewing eyepieces. They can be made from regular pliers by riveting two copper or aluminum plates to their jaws. A split lengthwise tube can be used instead of the cupropliers.

If cupropliers are not available, it is recommended to cover the eyepiece or the pliers' jaws with a protective rubber shield before unscrewing the eyepiece.

Lubrication

Correct and timely lubrication of all rubbing surfaces in the camera and in the lens is crucial for normal camera functioning and safety. Bad lubrication of touching surfaces is a common cause of camera malfunctions.

Different high-quality lubricants with certain viscosity are used for lubrication. The lubricant should not dry out, thicken, or freeze at relatively low temperatures. The lubricant must be stored in an airtight vial.

Not all assemblies and parts of the camera are lubricated with the same kind of lubricant. For example, delay mechanisms are lubricated with a very thin lubricant; gear and lever shafts are lubricated with a thicker lubricant; lens multi-entry threads are lubricated with an even thicker lubricant. Photo equipment can be lubricated with watch lubricant that has all the properties listed above.

It is recommended to mix thin and thick lubricants.

Watch lubricant, preferably Swiss, can be purchased at specialized stores which sell tools and equipment for watch repair. In small towns where such stores do not exist, the lubricant can be purchased from a local watchmaker.

Particularly dirty and dusty camera units that are easily disassembled should be washed in pure benzine prior to lubrication.

Do not overlubricate the parts because excessive lubricant spreads over the mechanism, including places that do not need lubrication at all. For example, excessive diaphragm lubrication results in condensed lubricant vapors on the lens elements, whereas excessive delay mechanism lubrication damages it by oiling either the clutch rollers or the spring.

Oil is applied with an oil-feeder shaped like a screwdriver and/or syringe. Its working part serves to form and release an oil drop and is made of non-oxidizeable material. If an oil-feeder is not available, a screwdriver with a 1-1.2 mm blade can be used.

An oil-feeder for the axles of the delay mechanism and for the leaf shutter mechanism is made of a string 3-4 cm long, attached to a wooden handle.

Repair and Replacement of Gear Teeth

Every camera has many gears of different shapes and sizes. Damage to the gear teeth can occur as a result of a gear shaft looseness. Screws which for the most part act as gear shafts may become loose. If a gear shaft is loose, its teeth can easily break the teeth of another engaged gear. This is how gears in "Zorki" and FED cameras break (see location 3 on Fig.121; 2 on Fig.125; 8 on Fig.127). More often than not the gear teeth are damaged and broken off as a result of an excessive load.

Incorrect film loading and choosing the wrong cartridges may hinder film advancement, the result of which is excessive load placed on the mechanism gears and, consequently, teeth damage. In the "Zorki-5" camera, for example, winding mechanism malfunctions are most common where the teeth of the gears *3*, *5*, and *6* (see Fig.225) are damaged or broken off. If a gear has one or more damaged teeth, they may be repaired or replaced.

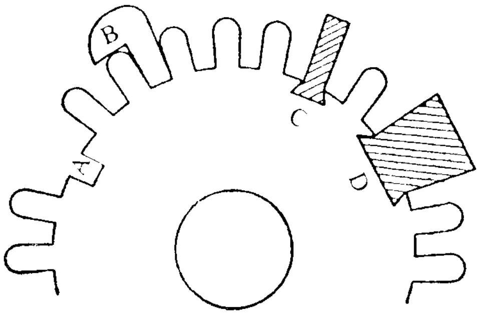


Figure 28. Gear teeth repair.

Most gears are made of brass and are easily repaired. A slightly bent tooth can be straightened out by bending it in the opposite direction with a large screwdriver positioned between the good and the damaged teeth. If a tooth is bent significantly, there is a big chance that it will break off during straightening. There are a few methods for tooth replacement.

To replace a tooth, make a slot A (Fig.28) in a gear rim with a handsaw or a file, insert a piece of brass tightly, and solder it. Slot A should be located in the middle between two undamaged teeth. Then file the new tooth and shape it using template B.

In areas where the load on the gear is the largest, the slot for the tooth must have a swallow-tail shape C. A similar kind of slot is made for the replacement of several teeth D.

"MOSCOW-2", "MOSCOW-4", AND "MOSCOW-5" CAMERAS

This whole line of cameras was produced by the same manufacturer. Over a period of time, the camera design was gradually modified and improved.

Knowing the design of the "Moscow-2" camera makes understanding other modifications quite easy.

"MOSCOW-2"

Major Camera Assemblies and Parts

The camera consists of the body *1* (Fig.29a), shutter *2*, front plate *3*, lens *4*, focusing lever *5*, rangefinder expansion joint *6*, bellows *7*, back plate *8*, knob *9*, top plate lock *10*, telescopic viewfinder *11*, shutter release button *12*, film rewinding lever *13*, levers *14* and *15*, handle *16* (Fig.29b), locking frame *17*, locking frame release button *18*, film spool centers *19*, focal frame *20*, take-up spool *21*, window with filters *22*, and pressure plate *23*.

Camera Disassembly and Assembly

The "Moscow-2" camera disassembly is very simple. The most important step is removing the shutter with the lens that is fastened with a nut to a panel. The nut is unscrewed with a key.

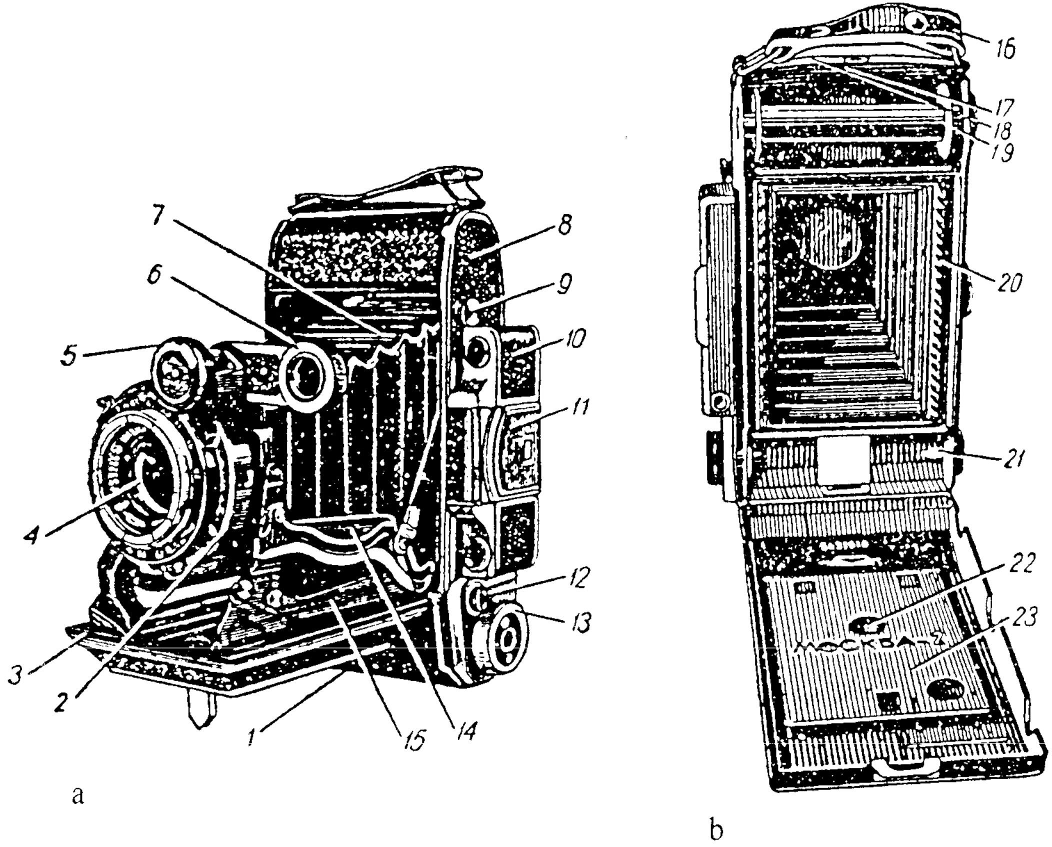
Details on how to disassemble the camera units are given in the description of the unit design and repair.

Camera Body

The camera body is collapsible and made of metal. The front flap plate can be turned on two hinges and opens by pushing the knob *9* of the lock (Fig.29a). While doing this, hold the panel with your right hand to prevent jerks that may twist the panel and deform the levers driven by the two strong spiral springs. The opened panel is supported by a lever system (Fig.30).

The levers are riveted for stronger construction, but this circumstance complicates the repair because of difficulties with disassembly.

If the camera falls, the lever system becomes deformed, and the lens panel gets loose. This causes the lens to twist and diminishes image sharpness. The impact usually damages one side of the levers, so it is best to compare deformed levers on one side with working levers on the other when repairing the camera. The lever *3* is especially susceptible to deformation.



a

b

Figure 29. The"Moscow-2" camera: a - the front view; b - the rear view.

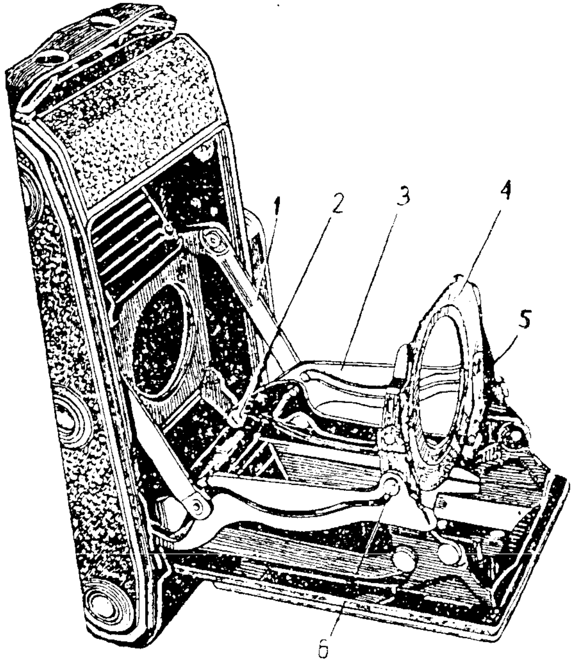


Figure 30. The camera body.

It is usually possible to fix the deformation of the levers without disassembling them. The disassembly should be performed only as a last resort because it is very time-consuming and requires certain skills. After the deformation has been eliminated, the lens panel in the open camera has to remain in a fixed position.

The panel *4* is locked with the levers *3* and *5*. The first step should involve checking up and straightening the levers. The longitudinal lever cut should allow unhampered traveling of the pin *6* that stays at the end of the cut when the camera is open. The lever is straightened in a half-open camera. In order to open the camera, the shutter and the bellows have to be removed. Most levers are made of brass, and they are, therefore, easy to straighten. Lever shafts have to be lubricated. To disassemble the lever system, unscrew the screws *2* (memorize the lever positions before disassembly).

After repairing the levers, the camera has to be adjusted.

The back plate opens when the locking clamp knob is shifted in the direction indicated by an arrow. The thin edges of the back plate may become deformed which will make it hard to close, and the light may penetrate the camera body. If the camera leaks the light when the bellows are not damaged, the back plate is malfunctioning. Bent edges have to be straightened with pliers or a mallet. Often the back plate is bent in the middle, and this obstructs the film advancement. If that is the case, remove the support pressure plate *23* (Fig.29b) and straighten the plate with the mallet. Make sure that the velvet strips on the pressure plate *23* do not come off.

Viewfinder

The viewfinder consists of two lens elements mounted in rimmed frames. The viewfinder opens simultaneously with the camera body. Under pressure of two springs the frame with the lens elements are set vertically. Figure 31 shows the viewfinder when the top plate is removed.

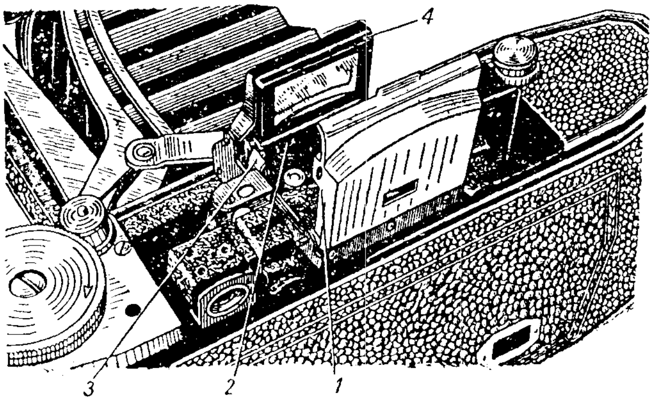


Figure 31. The optical viewfinder.

When the viewfinder is closed, the lock's spring *3* gets into the recess in the viewfinder top frame *1* and keeps it closed. Lock malfunctioning is the most common viewfinder problem. To fix it, bend the frame recess and the lock spring slightly with pliers. This should be done without removing the plate.

The frame springs have to be lubricated periodically. If the front lens element frame *4* does not open and hooks the shield *2*, check the frame shaft and straighten it if it is bent. Often the frame *1* is not vertical (in the open state). To fix the problem, remove the shield and slightly bend the two latches located under the frame *1*.

Film Transporting Mechanism and Release Interlocking System

The film in the camera is transported by a transporting mechanism (Figures 32 and 33), connected with a release interlocking mechanism.

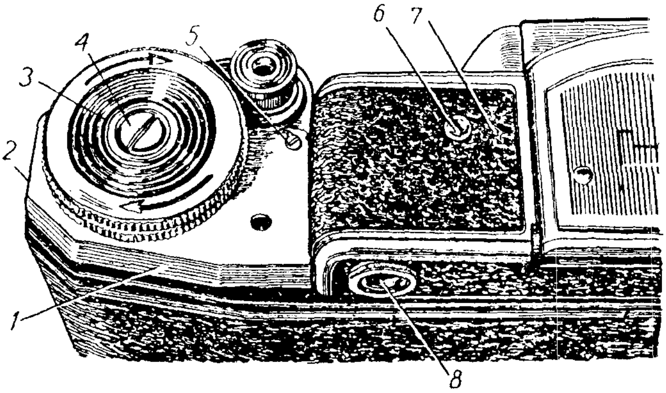


Figure 32. The exterior parts of the transporting and interlocking mechanism.

The transporting and interlocking mechanism consists of the winding handle *3* (Fig.32), figured lever *1* (Fig.33), spring *2*, plate *3*, clutch shoulder *4*, spring *6*, base clutch *7*, top clutch *8*, winding shaft with cross-piece *9*, lever *10*, release plate *11* and release button *12*.

Transporting and interlocking mechanism operational principle. When winding, the knob *3* (Fig.32) rotates clockwise, and the film is transported and reeled onto the spool. The base clutch *7* (Fig.33a) transfers rotational motion to the top clutch with the aid of the spring located between them. The top clutch pin *8* enters the hole in the winding handle , and its rotation transfers to the clutch. In addition, each of them can be rotated independently, i.e., one clutch can be turned overcoming the spring force and restraining the second one from turning. The base clutch *7* (Fig.33a) has two stampings and two shoulders (Fig.33b).

In the meantime, the top clutch *8* rotates, and its pin enters the hole in the winding handle. The top clutch rotates the base one. It hooks the lever bending *10* with its shoulder *4* and turns the lever along with the plate *3* where it is located.

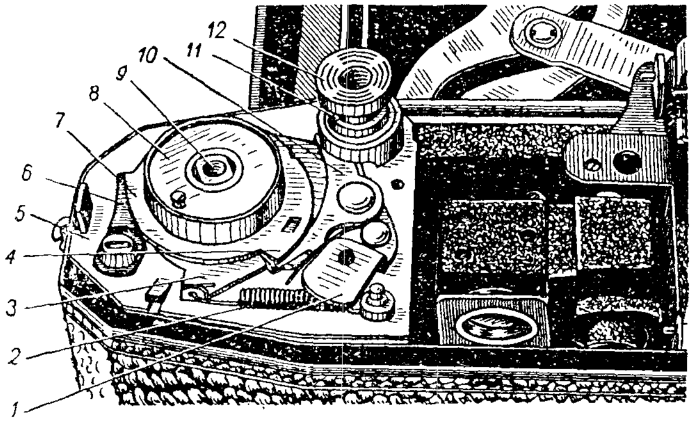
The plate *3* turns until the control red mark of the figured lever *1* appears in the shield *1* hole (Fig.32), and the mechanism is in the wound position. Meanwhile, the lever *10* (Fig.33a) emerges from the cut in the base of the release button *12* and opens the interlocking mechanism, i.e., the release button *12* and the release plate *11* (Fig.33a, b) which supports it can now move freely.

The entire mechanism in the wound position is fixed and held by the spring *6* installed on the base *5*. The plate with the lever *10* remains in this position until the shutter is released. When the release button is depressed, the plate *11* pushes the lever *10* with its sloped edge (see arrow on Fig.33c) and breaks this lever's link to the clutch *7*. The lever *10*, pushed by the spiral spring *2*, returns to its original position along with the plate.

Mechanism malfunctions. *1. **Dirty or corroded parts due to contact with moisture***. If the lever *10* (Fig.33a) turns on its shaft with difficulty, the interlocking mechanism fails. It is necessary to partially disassemble the mechanism, to clean the levers, and to lubricate the shafts and rubbing surfaces. When disassembling, first unscrew the screw *4* (Fig.32). Then remove the winding handle *3*, unscrew the top and side fastening screws *2* and *5*, and remove the protective shield *1*. The assembly is performed in the reverse order.

*2. **The winding mechanism is functioning properly, the film advances, but the red mark does not show up in the shield 1 hole, and the release interlocking does not open***. Remove the top shield *1* (Fig.32) and check the link between the clutches *7* (Fig.33a) and *8*. Turn the top clutch clockwise with your hand and watch to see if the clutch *7* turns and pulls the lever *10*. If there is insufficient friction between the clutches, the top clutch cannot turn the base one. The problem is fixed by strengthening the spring between the clutches. To do that, remove both clutches. After the top clutch is unscrewed and the spring is enforced by slight bending, reinstall the clutches.

a



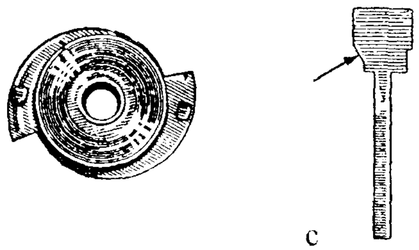


Figure 33. The transporting and interlocking mechanism:
a - overall view; b - clutch with shoulders; c - release plate.

*3. **The control mark shows up, but then disappears periodically.*** This problem is caused by displacement of the spring *6* (Fig.33a) which is attached to the base with the screw *5*. Check the fastening and bend the spring upward.

*4. **The head of the screw 4 (Fig.32) fastening the handle 3 has broken off.*** Remove the screw part remaining in the winding axle *9* (Fig.33a). Drill out the broken screw or make a cut 1-2 mm deep in the middle of the axle *9* with a handsaw. Insert a screwdriver into this slot and remove the screw. Then fasten the handle *3* (Fig.32) with a new screw.

5. ***The fork has fallen off of the rewinding axle.*** Remove the handle *3* (Fig.32) and take out the winding shaft *9* (Fig.33a). The brake spring on the shaft prevents counter-clockwise rotation of the handle. One end of the spring is bent and placed inside the hole in the winding shaft's bushing. If the shaft cannot be taken out easily, apply some force. Pull it down toward the fork.

To fasten the fork, drill a hole in the winding shaft and in the fork, insert a pin, and rivet it on both sides or solder the fork. If you use silver solder, remove the brake spring so that the heat does not damage it.

Shutter Release Mechanism

The shutter release is accomplished by the turn of the lever *6* (Fig.35) driven by a special mechanism that consists of a system of levers. The mechanism consists of the release button *12* (Fig.33a), the release plate (Fig.33c) underneath it (part of the plate is shown on Fig.34), the intermediate lever *1* (Fig.34), the spiral spring *2*, and the release plate *4* turning on two shafts in the brackets *3* and *5*. The release plate *4* turns the release lever *6* of the shutter (Fig.35). After the shutter release, the lever system driven by the spring *2* (Fig.34) returns to its starting position.

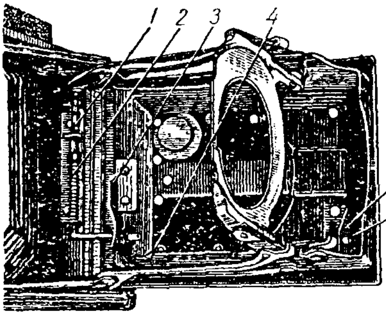


Figure 34. The parts of the shutter release mechanism.

Shutter release mechanism malfunctions. 1. ***After the shutter release, the lever system returns to its starting position very slowly or does not return at all.*** It is necessary to lubricate the rubbing surfaces, especially the holes holding the plate *4* shafts (Fig.34). The spiral spring *2* and the release plate *11* (Fig.33a) also require lubrication.

2. ***The release mechanism gets stuck.*** This problem is caused by the release plate *4* shafts (Fig.34) being displaced from the brackets *3* and *5* as a result of incorrect camera closing. The shaft *6* falls out more often. To fix this problem, place the shafts of the plate back in their sockets.

3. ***The shutter is not released even though the release mechanism works correctly.*** First of all, check the shutter. Release it by turning the lever *6* (Fig.35) with your finger. If the shutter is functioning, it means that the release mechanism, or, to be exact, the plate *4* (Fig.34), does not turn the lever *6* (Fig.35) sufficiently for the shutter release. The lever 6 has to be turned at a certain angle; otherwise, the shutter release will not occur.

The shutter is fastened to the lens panel with a nut and a pin. If the fastening nut loosens, and the shutter shifts slightly, the plate *4* (Fig.34) is unable to push the release lever *6* of the shutter (Fig.35) far enough, and the lever does not sufficiently turn the pawl *6* (Fig.36a).

If the shutter is in place and well fastened, but the release does not occur, it means that the shoulder of the lever *6* (Fig.35) is deformed. In that case, disassemble the front part of the shutter and straighten the lever. It is a time-consuming process and requires lens and rangefinder adjustments. Therefore, bend the end of the lever 6 toward the plate *4* very carefully (Fig.34) with pliers.

Shutter

The "Moscow-2" camera is equipped with the "Moment-1" leaf shutter which is one of the most advanced types of shutters. The "Moment-1" shutter speeds range is from 1 sec to 1/250 sec plus the time "B". The design of the shutter is so complicated that its repair requires certain skills.

Before studying the shutter disassembly, design, and operational principles, it is necessary to master disassembly of the rangefinder and the lens, since they form one unit with the shutter.

The rangefinder superstructure and the lens are disassembled in the following order: remove the shutter with the lens and the rangefinder's optical compensator by unscrewing the fastening nut inside the camera with a key (see Fig.25). Do not forget that the round metal adjusting shims between the shutter and the panel will have to be reinstalled. When this is done, unscrew the three set screws and remove the chromed connection ring *6* (see Fig.41a). Unscrew the screw *1* (see Fig.42) and remove the optical compensator shield *2*. There are two screws shown on Figure 42, but only the left one marked *1* can be unscrewed; the second screw holds the optical compensator panel in place and should not be touched. Unscrew the screw *4* (Fig.41a) and remove the decorative piece *5*. While holding the gear *1* (Fig.43a) with the left index finger, unscrew the screws *7* (Fig.41b) and remove the handle *2* (Fig.41a); unscrew the four screws *9* (Fig.41b) and remove the shield *8*; remove the gear *10* (Fig.41c) and the ring gear *14*; unscrew the screws *15* (Fig.41d) and remove the back panel with the optical compensator. While doing the above, hold the gear *1* (Fig.43a) in link with the other two optical compensator gears. Then unscrew the four screws *16* (Fig.41d) and remove the panel *18*; unscrew the mount with the front lens element *1* (Fig.41a) after cutting a thread mark (see p.52); remove the mount *17* (Fig.41d) with the second lens element (see p.52); and, finally, remove the mount with the two rear lens elements.

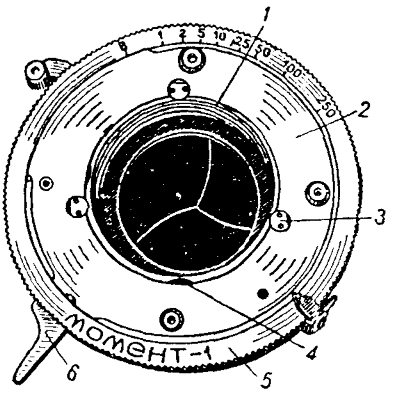


Figure 35. The "Moment-1" shutter.

Having removed all lens and rangefinder parts, start the shutter disassembly. The shutter mechanism is contained in the body and capped with the round plate *2* (Fig.35). To remove it, open three locks *3* by turning them with the key or tweezers in either direction. Then turn the plate to align its guides (three of them) with the grooves *4* and remove it. The ring *5* is used for time-setting.

When the ring *5* is removed, all the major parts of the shutter become visible (Fig.36a). The winding ring *2* with a handle on it is placed over the shutter base body tube. The winding spring *7* (it is seen more clearly on Fig.36c) and the traveling lever *12* (Fig.36c) are affixed to the ring. The delay mechanism *5* (Fig.36a) is fastened with three screws. The release lever *9* with two cuts, the spiral ring *11*, and the lever *10* are set on the shafts; the bracket with the pawl *6* is fastened with one screw; the slotted guiding plate *1* is positioned on the shaft; the lever *8* is attached with a screw; on the reverse side of the mechanism (Fig.37) there are the ring-link and the shutter blades *4*.

Shutter operational principle and parts' interaction. The parts' arrangement in the unwound shutter is shown in Figure 36a. The release lever *9* is fixed securely because one of its shoulders is held by the lever *10*, and the other is leaning on the pawl *6* shoulder. Therefore, the lever is blocked and cannot turn. This is the second blocking of the untimely shutter release (the first one was described on p.49). The spring pushes the pawl *6* to the winding ring *2*, while its hook is in one of the ring's recesses. Pay special attention to the complex shape of the ring: it has many recesses, curves, levers and claws.

The delay mechanism pallet is located on the moving lever *3* and operates at the turn of this lever. The lever *3* rests on the ring *2*. The delay mechanism is shown in Figure 36b.

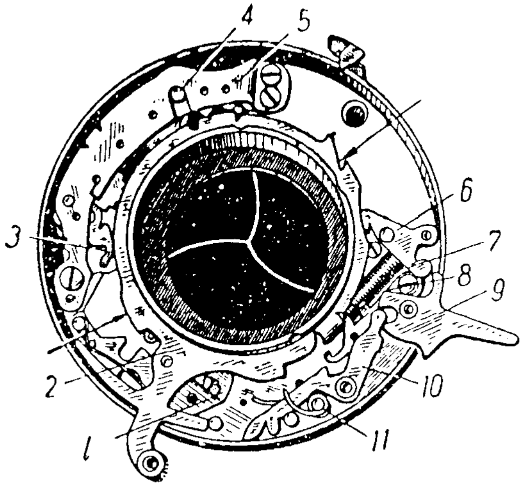
Winding the shutter changes the position of the ring *2*. The hook of the pawl *6* drops behind the shoulder (see Fig.36a, an arrow on the right) and holds the ring *2* in the wound position, while the ring is driven by the spring *7* to the starting position. When the pawl *6* hook drops behind, the clutch turns a little and lets the lever *9* turn, i.e., the interlocking is released. At the same time the ring *2* turns the lever *3* with its shoulder (see Fig.36a, an arrow on the left) and switches on the pallet; the delay mechanism gears and the segment gear *4* are both allowed to turn free. When the shutter is not wound, the winding ring *2* bending (see arrow in Fig.36c) is next to the segment gear *4* (Fig.36a), and holds it in place. When the shutter is wound, the bending on the winding ring changes its position and moves away from the segment gear *4*. The ring *2* simultaneously turns the lever *3* and switches off the pallet so that the gears and the segment gear *4* can now turn freely. Driven by the spring on its shaft, the segment gear *4* returns to its original position. The shutter is wound.

The shutter is released by the turn of the lever *9*. The lever turns the pawl *6* which releases the winding ring *2*. The ring is driven forward by the spring *7*. It releases the pallet *3* lever, and the pallet is set to working position. The bending on the ring *2* reaches the shoulder of the segment gear *4* and turns it. The segment gear's spring is much weaker than the spring *7*. The turning segment gear sets the delay mechanism gears in motion, but the pallet slows them down. They rotate slowly, and so does the segment gear *4* which holds the ring *2*. The delay time is about 1 sec.

The shutter blades turn around the shaft-screws 3 (Fig.37). Every blade has a pin that enters the slit in the ring-link *2*. When the ring-link turns by 5-7°, the shutter blades open completely.

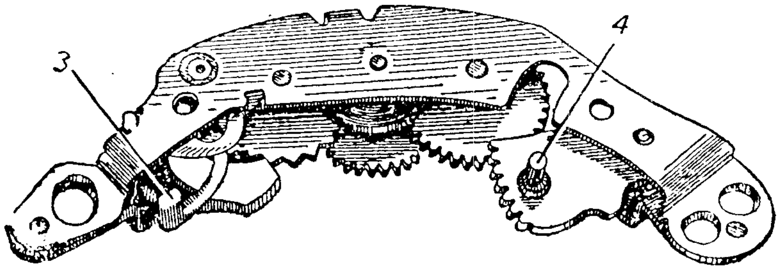
The ring-link 2 is connected with the slotted guiding plate *1* (Fig.36a) of the shutter mechanism by a pin in the shutter base *1* opening (Fig.37). (An oval opening is shown on Fig.36c.) The slotted guiding plate *1* (Fig.36a) has two shoulders, and it turns around the shaft. The thin string spring rests on the narrow shoulder. If the slotted guiding plate *1* is turned by its narrow end, the shutter blades will also turn and open; if the slotted guiding plate is released, the blades will close. The ring *2* performs the same operation. The faster it moves, the faster the shutter blades turn.

Shutter speeds. The necessary shutter speed is set by the ring *1* (Fig.38a).

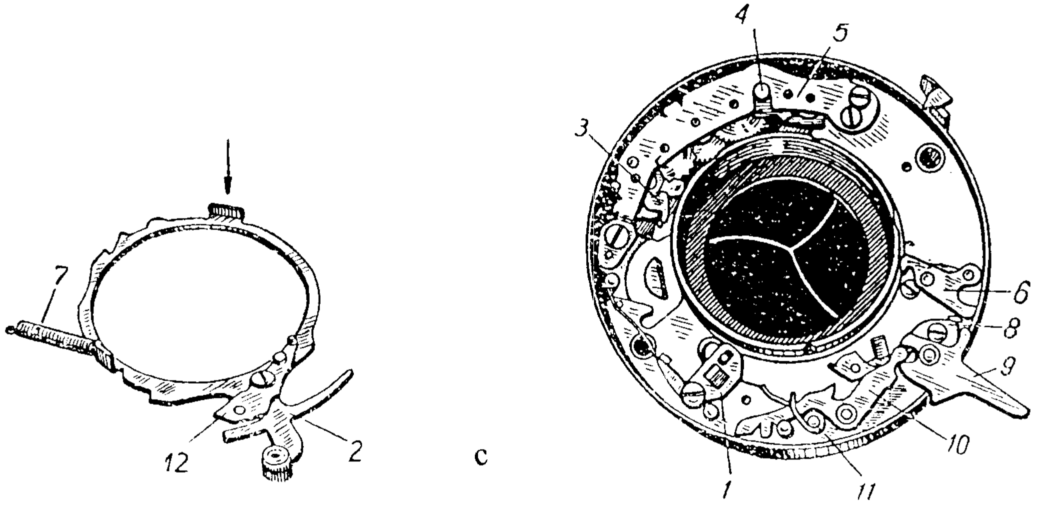


a

Figure 36. The shutter mechanism:
a - overall view; b - the delay mechanism;
c - when the winding ring is removed.



b



c

The ring controls the position of the delay mechanism parts (Fig.36a) and of the lever *8* that sets a certain shutter speed. The lever *8* has a vertical bending (see arrow on Fig.38), and the ring *1* has a notch in the same place. Therefore, the bending on the lever, positioned against the ring's notch, can slightly shift forward (the lever *8* on Fig.36c has a spring turning it). In addition to the vertical bending, the lever *8* also has a pointed bending which can stop the winding ring *2* (Fig.36a) when the ring *1* (Fig 38) is in position *a*. When in position *b* (Fig.38), the ring *1* prevents the lever *8* (Fig.36c) from turning, and the winding ring *2* (Fig.36a) shifts to the original position without delay. Note the following: when the winding ring moves, it turns the slotted guiding plate *1* by means of the lever *12* (Fig.36c); this slotted guiding plate is connected with the shutter blades and opens them.

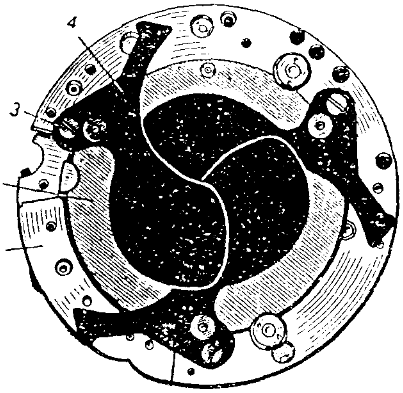
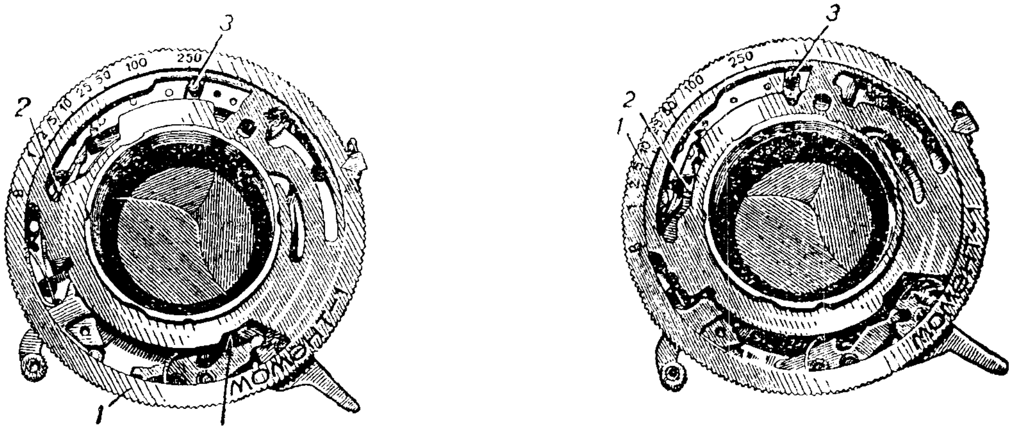


Figure 37. The shutter base and blades.

While setting the "B" speed, the lever *8* stops the winding ring *2*; at this moment the blades are completely open. They remain in this position until the release of the lever *9* which turns the lever *10*; the bending on this lever, in turn, releases the lever *8*. When the "B" speed is set, the delay mechanism *5* is switched off, i.e., the lever *3* (Fig.36a) and the pin of the segment gear *4* are set by the winding ring *1* (Fig.38) in a position where they cannot move.



a

b

Figure 38. The shutter speed-setting ring:
a - at setting the "B" speed; b - at setting speed 1 sec.

All the other automatic shutter speeds involve the delay mechanism *5* (Fig.36a); meanwhile, the ring *1* (Fig.38) sets the lever *8* (Fig.36a) in the idle position.

The automatic shutter speeds are controlled by the time and the turning angle of the segment gear *4* in the delay mechanism *5*. The pallet of the lever *3* and the delay mechanism segment gear *4* work with 1, 1/2, 1/5, and 1/10 sec speeds. When the ring *1* (Fig.38) is set to these speeds, the lever *3* (Fig.36a) starts moving and involves the pallet and the segment gear *4* pin. The positions of the ring *1* and other parts: lever *8* bending (Fig.36a), lever *3*, and pin *4* at 1 sec shutter speed are shown on Figure 38b. The segment gear *4* angular turn changes depending on the set speed. The larger the segment gear angular turn, the greater the shutter speed. When the speed is set to 1/25, 1/50, 1/100, or 1/250 sec, only the segment gear *4* works; the lever *3* and the pallet are turned off by the turn of the ring *1* (Fig.38). While setting the ring *1* to any automatic speed the segment gear *4* pin (Fig.36a) turns and controls the segment gear's turning angle.

Meanwhile, the winding ring *2* (Fig.36a) moves (after pushing the release lever *9*) and hits the shoulder of the segment gear *4*, and the time of the winding ring *2* motion depends on the time it takes the segment gear *4* to turn. The ring *2* along with the shutter blades move at the speed controlled by the segment gear *4*. The longest segment gear turn takes about 1 sec (when the delay mechanism's pallet is on), and the shortest turn takes 1/100 sec.

At the speed of 1/250 sec the spring *11* is involved; it increases the speed of the ring *2*. When the ring *1* (Fig.38) is being set to 1/250, it moves with greater difficulty. This means that the spring *11* is engaged (Fig.36a).

Complete shutter disassembly is done in the following order: open the locks *3* (Fig.35), remove the plate *2* and the shutter speed ring *5*, free the spring *7* (Fig.36a) and remove the winding ring *2*, release the lever *9*, then the lever *10* and the spring *11*, unscrew the three screws on the back of the body and take out the interior body *1* (Fig.37) where all the parts mentioned above are mounted. Finally, unscrew the screw *3* and remove the shutter blades *4*. It is recommended to mark the blades and the screws for future assembly.

Shutter malfunctions and their elimination. 1. ***The "B" speed is not working.*** When the lever *8* (Fig.36c) movement is not adjusted, the lever in its motion does not reach the shoulder of the winding ring *2* and does not catch it. In this case, it is necessary to bend slightly the lever *8* vertical bending so as to increase the lever's angular turn. Sometimes the "B" speed does work, but the blades stay open after the freeing of the release lever. If that is the case, bend the lever *8* vertical bending in the opposite direction to reduce its angular turn.

If the spring fastened on the lever 8 is weak or broken, the lever *8* will not move at all. Thus, the spring has to be bent and strengthened or else replaced. To do that, take a piece of a string, clean the place on the lever where it will be attached, and make a small dent in it with the three-edged file. Place the end of the string in that dent, and solder it fast so that the spring does not heat up. After the soldering, clean the lever carefully and remove excessive tin.

2. ***The shutter blades do not open completely.*** This problem may be caused by several factors:

a weak spring pushing the shoulder of the slotted guiding plate *1* (Fig.36a) and turning it in the starting position. To correct the problem, strengthen the spring by bending it more;

the shutter blades have oil on them, and their movement is obstructed. Remove the blades and wash them in benzine;

the heads of the screws fastening the ring-link *2* (Fig.37) are deformed, and they obstruct he link's movement;

the screws *3* serving as the blade shafts are either too tight or too loose, and the turning of he blades is obstructed. Check whether every blade turns freely on the shaft;

the blades are deformed. Straighten them. They should be flat, without jags on the edges.

3. ***The release lever is malfunctioning.*** Sometimes, after the shutter release, the release ever *9* (Fig.36a) does not return to its original position. It hinders the function of the pawl *6*, and makes it impossible to wind the shutter once again.

Check what prevents the lever from returning to its starting position; check its shaft.

Since the release lever returns to its starting position with the help of the lever *10*, check whether the lever turns freely. The lever spring can be strengthened by removing the lever and traightening the spring a little.

4. ***When the release button is pushed, the release lever turns insufficiently, and the hutter does not function.*** At the time of the shutter release, the lever *9* (Fig.36a) has to reach a ertain position where the pawl *6* releases the winding ring *2*. Sometimes the shutter release mechanism does not turn the release lever *9* sufficiently (see p.45).

5. ***The low shutter speeds are malfunctioning.*** The functioning of the low hutter speeds is governed by the delay mechanism with the pallet (Fig.36a, b) turned on. The delay mechanism *5* is fastened with three screws. Screw holes in the mechanism's dove-tails are oval which allows the mechanism to shift slightly when the screws are not tightened. The adjustment at 1/10 sec speed is easier and more precise. The gap between the segment gear *4* pin and the specially shaped groove‘s wall of shutter speeds ring 1 (Fig.38a) should be minimal. If the 1/10 sec shutter speed works with the minimal gap, all the other shutter speeds will perform relatively well too.

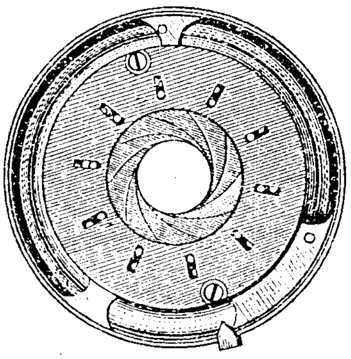


Figure 39. The shutter and the diaphragm body.

6. ***At shutter winding the winding ring 2 (Fig.36a) does not stay in the reset position and returns to the starting position arbitrarily***. (The pawl *6* does not hold the winding ring hook.)

There are several factors that may cause this malfunction. One of them was described in problem *3*. Another one could be that the pawl hook is broken (a relatively uncommon occurrence). In this case, make a new steel pawl and temper it. The third reason could be an ncorrect adjustment of the pawl which is pressed by the release lever shoulder. If this is the case, bend the shoulder a little.

Shutter cleaning and lubrication. The shutter may stop working because of dirt and corrosion of the parts. The shutter parts have to be lubricated with watch oil and cleaned with a brush that has been dipped in benzine. It is also necessary to oil all lever shafts, the winding ring and the lever shaft on it, and the delay mechanism gears shafts (slightly). Never oil the ring-link, the shutter blades, and the diaphragm.

Diaphragm

The "Industar-23" shutter iris diaphragm (see p.33) is located inside the shutter between the exterior and interior bodies. There is a figured steel shim between the shutter blades and the diaphragm. The diaphragm (Fig.39) has ten blades and a crown connected to a tang with two screws.

Lens

In the "Moscow-2" camera, the "Industar -23" lens is installed in the leaf shutter mount.

The "Industar-23" is a four-element, half-cemented anastigmat with a rear component consisting of two lens elements cemented together. The lens optics are coated. The optical layout of the "Industar" lens elements is shown in Figure 149.

Specifications

Focal length	110 mm
Relative aperture	1:4.5
Field angle	52°
Distance scale range	from 1.5 m to ∞
Resolution in lines per 1 mm:	
in field center	28
on field edges	14

Lens design. The lens consists of the first (front), second, third and fourth (the latter two are cemented together) lens elements in mounts. The mounts of the second and the third lens elements are fixed, while the first one turns on a thread.

Lens disassembly and reassembly. The lens can be disassembled when the shutter is either removed or not. The third mount is unscrewed with a key. To unscrew the mount with the front lens element, it is necessary to take off the front chromed rim *6* (Fig.41a) fastened with three set screws. The rim is easier to take off when the index mark 1.5 m is aligned with the pointer on the shield *8* (Fig.41b).

The top of the front lens element mount and the shield *8* then have to be marked for future reassembly. After that, unscrew the mount slowly and count the rotations made by the mount (or, rather, by the mark). When taking the mount off, trace the mount marked position on the shield *8* so that you can start reassembling at the correct thread entry. As a last resort, it is possible to start with any thread entry and then to adjust the camera body and the lens (see p.57).

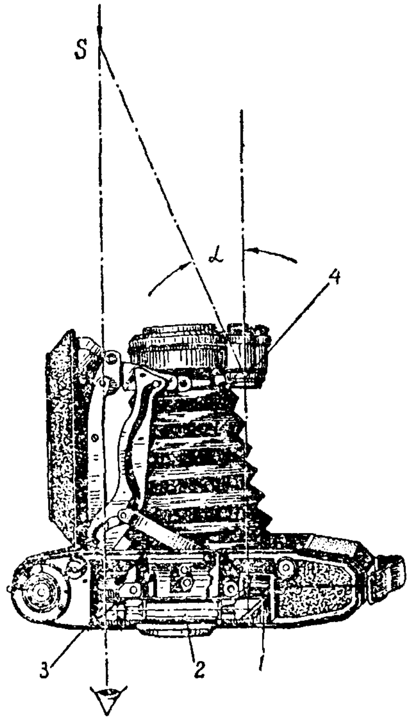
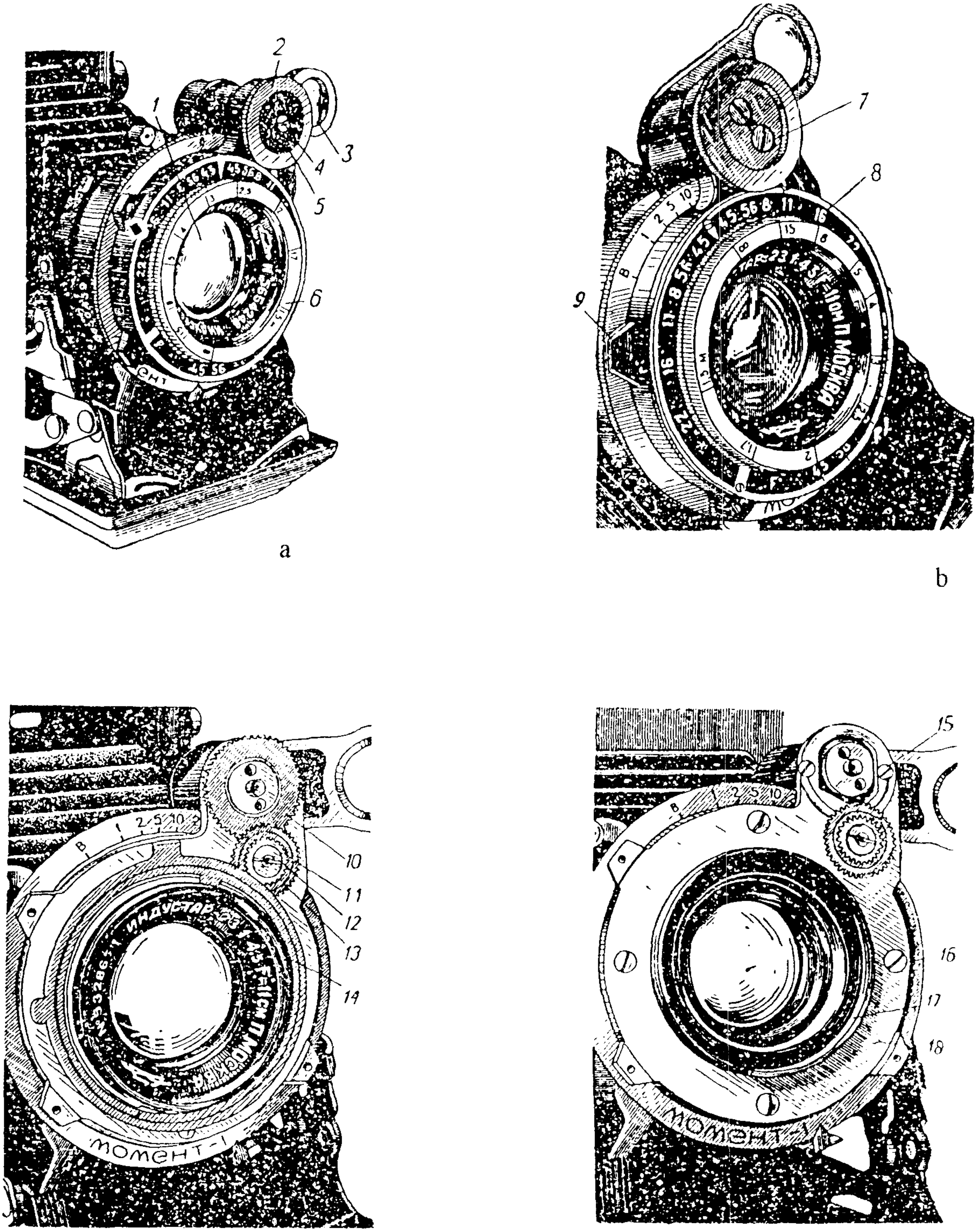


Figure 40. A diagram of the rangefinder.



a

b

c

d

igure 41. The rangefinder's exterior parts:
- overall view; b - with the decorative shield removed; c - with the exterior shield removed; d - with the front ns element removed.

The front lens element mount is screwed in the mount front of the second lens element. Therefore, the second lens element mount *17* (Fig.41d) can be unscrewed only when the first lens element is removed.

The unscrewing of the second lens element mount has to be done only with a special tool if you do no want to damage the lens. The mount front has two slots for inserting a thin metal plate resembling a ruler. After this is done, the mount can be unscrewed. If the mount is squeezed (with pliers or a vice, for instance), the interior thread will be destroyed, and the lens will be unfit for use. The latest cameras of the "Moscow" line have through holes for unscrewing the lens.

Lens malfunctions. 1. ***Dirty lens.*** It is usually possible to clean the lens (the front and the back elements only) without disassembly or with partial disassembly. Avoid complete disassembly because lens adjustment is required afterwards. When partially disassembling, remove the third and fourth lens element mount screwed on a thread.

2. ***Front lens mount rotation is obstructed.*** Replace the lubrication of the front lens element mount.

3. ***The second lens element mount is loose.*** When the lubricant on the front lens element mount has dried out or thickened, the mount does not rotate relatively to the fixed second lens element mount, but unscrews it and rotates with it. This problem is indicated by blurred negatives. Place a ground glass in the focal plane as you did for camera adjustment (see p.57) and check focusing. If this is the problem, you will not be able to focus. Unscrew the front lens element, tighten the second lens element, and adjust the lens (see p.57).

Camera Adjustment

The "Moscow-2" camera adjustment includes two steps: rangefinder adjustment and adjustment of the body and lens.

Rangefinder. The "Moscow-2" camera is equipped with a rangefinder, its optical wedge compensator mechanically connected to the traveling front lens element. The rangefinder consists of two independent units: the block of the cemented prisms *2* (Fig.40) with a beam splitting coating on the cemented joint; and the optical wedge compensator *4* comprised of two glass round optical wedges rotating in opposite directions and forming a three-sided prism with a changeable refraction angle (see p.23).

The block of the cemented prisms is fixed on the side wall of the body; the compensator is movable and retracts at the collapsing of the camera. The rangefinder basis is 65 mm.

Rangefinder operational principle. Consider a subject at point S. Through the eyepiece you can view two subject images: real and imaginary. The real (directly viewed) image is seen through the semi-transparent beam splitting layer *3*, applied on the prism joint at a 45° angle to the viewer's eye. The imaginary (shifting) image is projected through the compensator's optical wedges *4* and is reflected by two prism block planes. Its area is two times smaller than that of a real image.

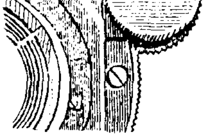


Figure 42. The rangefinder compensator shield.

While rotating the handle *2* (Fig.41a) connected with the compensator *3* and the front lens element, find a position where the two images coincide. During this process the optical wedges change the parallax angle (see p.23), and the front lens element rotates to provide focusing precision.

Rangefinder malfunctions and adjustment. Before adjusting the rangefinder, it is necessary to check if all the other units and devices are functioning correctly and to completely assemble and adjust the camera.

There are two kinds of rangefinder adjustment: vertical and horizontal. If during rangefinding the second image is seen to be shifting not exactly in the horizontal direction (while the camera is oriented horizontally), but from top to bottom or vice versa, it means that the vertical adjustment is off. If the shifting image slides exactly horizontally, but either passes the ∞ sign or stops short (passes or stops short of the fixed infinitely distant subject image), the horizontal rangefinder adjustment is off. The vertical adjustment is checked and set by any horizontal line, the vertical one - by a tower or a mast located infinitely far away (100 m).

Minor rangefinder disassembly is required for the horizontal adjustment; the vertical adjustment involves more complex disassembly of the optical wedges.

The horizontal adjustment is done as follows: unscrew the screw *4* (Fig.41a) and remove the decorative plate *5*, then unscrew the screw *1* (Fig.42) and remove the compensator shield *2*.

Loosen the screws *7* (Fig.41b) by one or two rotations; this will disengage the compensator mechanism and the lens. With two fingers of your right hand turn the handle *2* (Fig.41a) as you would for rangefinding until both images (shifting and fixed) of the infinitely distant subject coincide. Make sure that the front lens element mount rotates toward infinity, and the ∞ sign stops opposite the arrow. Sometimes the shifting image (in the rangefinder) slides toward ∞ sign and the front lens element mount - toward 1.5 m. In that case continue the handle *2* rotation. The shifting image will pass the subject observed at infinite distance and will start shifting in the opposite direction, i.e., toward 1.5 m. Simultaneously the front lens element mount will reach the 1.5 m mark and stop until the shifting image also reaches 1.5 m.

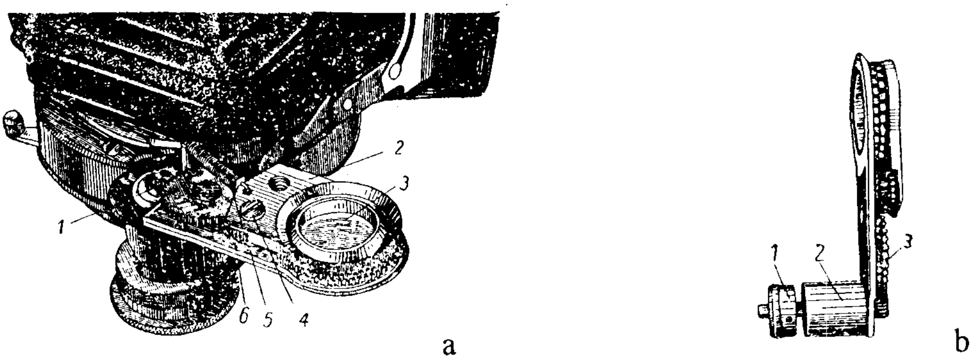


Figure 43. The rangefinder compensator:
a - installed in the camera; b - removed from the camera.

Tighten the screws *7* (Fig.41b) slightly, and point the rangefinder again at infinity. Now the front lens element mount will turn toward the infinity (∞) sign. Upon reaching it, the lens element mount will stop. Continue turning the handle *2* until the two images (shifting and fixed) coincide. When the lens element mount reaches the ∞ sign, it will be somewhat harder to rotate the handle. At that point you should tighten the screws *7* using your finger to hold the gear *1* in link with other gears and to prevent the lens panel from deformation.

The vertical rangefinder adjustment is somewhat more difficult. First do the vertical adjustment and only then the horizontal. The vertical rangefinder adjustment is done by the compensator (Fig.43a, b) consisting of the base *6* (Fig.43a) fastened to the tube *2* (Fig.43b), the gear system *3*, optical wedges *3* (Fig.43a), the plate *2*, the gear *1* and its shaft running inside the tube. The pin tube *1* (Fig.43b) is fastened to the gear *1* shaft. The reverse side of the base is covered with a decorative black plate fastened with a screw; this is never disassembled.

Each optical wedge *3* (Fig.43a) is fixed in the mount. The side of the optical wedge mount has a thread for connection with the gear linked to the handle *2* (Fig.41a). Without disassembly of the gear system and without removing the handle *2*, rotate the optical wedge mount until the rangefinder is adjusted vertically.

The manufacturer injects shellac glue between the optical wedge mount and the gear to prevent arbitrary optical wedge shifting. Therefore, to be able to rotate the optical wedge mount, put on it a piece of cotton dipped in alcohol for 10-15 minutes. This will dissolve the glue. The optical wedge mount has two slits for the socket. To adjust the compensator, turn the front optical wedge mount by a small angle until the images coincide. Having completed the vertical adjustment, start the horizontal adjustment as described above.

Very often the rangefinder adjustment flits off either because the optical wedge in the mount is loose or else the mount is loose in the gear. Make a point of always checking the optical wedge fastening during the repair. If you should discover a loose optical wedge, after freeing the spiral spring *5* (Fig.43a) and unscrewing the screw *4*, remove the plate *2* and take out both optical wedges with the mounts and the gears. Make sure to identify the exact location of the loose fastening, whether it is the loose optical wedge in the mount or the loose mount in gear. To secure the optical wedge in the mount, very carefully, trying not to break the optical wedge, run the screwdriver along the rolling. To secure the mount in the gear, use shellac glue. There is no other way of doing it without breaking the optical wedge. After the optical wedges are checked and secured, reinstall them.

To make the optical wedge adjustment easier, install the lower optical wedge first (see Fig.43a). Place the shifting image in the topmost position, and adjust the bottom optical wedge so that both images coincide. Precise optical wedge adjustment is done the same way, but their correct installation is almost always possible by a single gear and upper optical wedge mount rotation, shifting the gear one or two teeth back and forth.

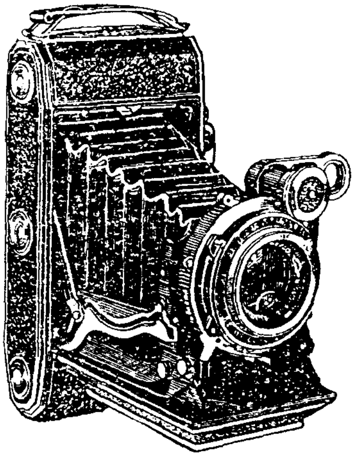
Often the rangefinding is complicated by the obstruction of the rotation of handle *2* (Fig.41a). The rangefinder is connected with the front lens element mount rotating on a multi-entry thread. The thread is lubricated but the oil often dries out, thickens, and gets dirty. To make the front lens element move easily and smoothly, unscrew the front lens element mount and replace the old oil with new oil (watch oil is best). The old oil is removed with a piece of cotton dipped in benzine. After the lubrication, the thread is reinstalled (see p.52). The adjustment of the body and lens is then checked.

In addition to the lens mount, other rubbing surfaces of the rangefinder mechanism may be lightly lubricated: the compensator gears shafts and the gears *13* and *14* (Fig.41c).

Malfunctions are often caused by a poor linkage between the gear *13* and other echanism gears. This malfunction is indicated by crackling gears and by the absence of coupling f the rangefinder with the lens mount. The gear adjustment is done in the following order: loosen y one rotation the screw *12*; push the shaft *11* with gear *13* toward the gears linked by it and sten it with the screw *12*. These parts are positioned under the shield *8* (Fig.41b) fastened with e four screws *9*. Remove the compensator shield; in order to remove the shield *8*, first remove e handle *2* (Fig.41a), while holding the gear *1* (Fig.43a) with your left finger. If the repair is omplicated and long, remove the compensator by freeing the spring *5*. Finally, place the removed ompensator on the bench so that the gear *1* does not come off.

Dirty rangefinder prism block. The rangefinder prism block and the protective glass on e top shield gradually become dirty which significantly worsens the visibility. Therefore, they ould be cleaned regularly, every 6-12 months. To do that, after unscrewing the two screws *6* ig.32) and the eyepiece *8*, remove the protective shield *7*. With a piece of cotton dipped in cohol, wipe all prism block surfaces not covered with flat paint: the eyepiece *8* and the rotective glass on the shield.

All the rangefinder' malfunctions should be eliminated at the same time. For example, uring the rangefinder adjustment, first remove the top shield *7* (Fig.32) and clean the prism block for better visibility, then lubricate all the rubbing mechanism surfaces and clean the optical wedges.



gure 44. The "Moscow-4" camera.

Body and lens adjustment. The body and lens adjustment follows the rangefinder adjustment.

The adjustment is done by rotating the mount with the front lens element. Any thread entry can be used. Prior to that, the thread should be oiled. All the other lens elements are fixed.

After the front lens element mount is tightened, proceed with focusing by the infinitely distant subject on the ground glass. To do that, set the shutter speed to "B" and wind the shutter. Then open the back cover and place the ground glass on the film track with the ground surface facing the lens.

Reset the film release mechanism and hold the camera keeping your right index finger on the release itton and holding the ground glass with your thumb. Push the release button and open the utter blades. With your right hand turn the front lens element mount until you get the sharpest age of the infinitely distant subject (a radio antenna or a flue at a distance over 100 m). Then perpose the rangefinder and the lens.

Similar to the lens, the rangefinder should be set to infinity. Put the connecting exterior g *6* (Fig.41a) on the front lens element mount, and fasten it with three set screws. Drill small les for the set screws of the connecting ring in the lens mount. The ring has an opening for the ngefinder gear bending *14* (Fig.41c).

Correctness of the "Moscow-2" camera adjustment is checked as follows. Using the ground glass, focus on a poster or a sign 4-6 m away; either look in the rangefinder eyepiece and check to see if both images coincide in the rangefinder, or do the rangefinding and then check the focusing on the ground glass. If the rangefinder and the lens do not superimpose, do the correction using the front lens element without touching the rangefinder.

"MOSCOW-4"

The "Moscow-4" camera (Fig.44) is an improved modification of the "Moscow-2" camera. It has a flash synchronization mechanism and is equipped for making 6x6 cm negatives. The repair of the shutter, rangefinder, and other devices is done the same way as described for the "Moscow-2" camera.

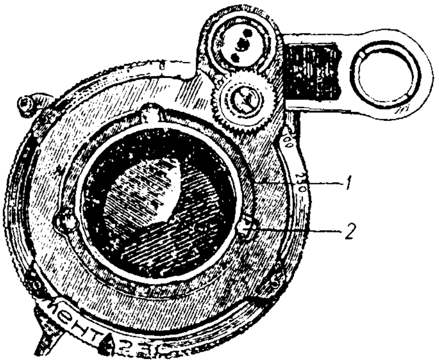


Figure 45. The front of the shutter.

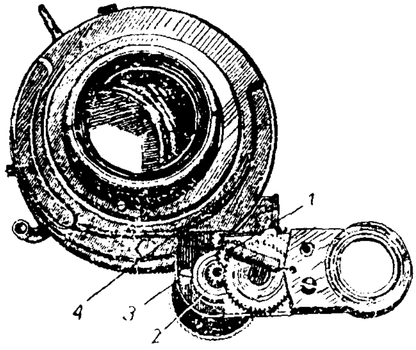


Figure 46. The base and compensator of the rangefinder.

Shutter Disassembly

Shutter disassembly is impossible without disassembling the rangefinder superconstruction. The "Moscow-4" camera has a rangefinder superconstruction of a somewhat different design and with different disassembly sequence. In the "Moscow-2" camera the panel *18* (Fig.41d) is fastened with four screws *16* and two screws *15*. The round shutter plate *2* (Fig.35) is positioned under it. In the "Moscow-4" camera both parts are combined in one - part *1* (Fig.45).

To disassemble the "Moscow-4" camera superconstruction, remove the shutter by unscrewing the fastening nut inside the body.

The remaining disassembly steps are the same as for the "Moscow-2" camera (see p.45).

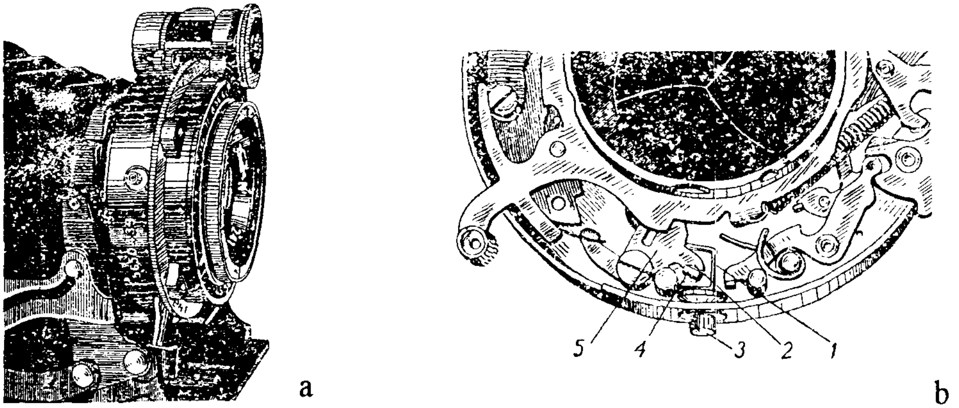
To remove the front shutter panel *1* (Fig.45), open the locks *2*, free the spring *1* (Fig.46) and remove the compensator *2*; unscrew the two screws *3* and remove the back plate *4*. Do not forget to adjust the shims between this plate and the lens plate. Then holding the shutter in your left hand, turn the front plate *1* (Fig.45) with your right hand 10-15° until the guides on the plate coincide with the grooves in the shutter body base. You can now safely remove it.

The reassembly is done in a reverse order.

Flash Synchronization Mechanism

The flash socket *7* is located on the shutter body (Fig.47a), and the contact mechanism is nside it (Fig.47b). There is a wireless connection between the flash socket and the contact nechanism. The contact mechanism itself is simple and reliable. The contact spring *1* is fastened o the flash socket *3* (Fig.47b). The slotted guiding plate *5* has the bending *4* which touches the pring *1* and closes the electric circuit when the guiding plate turns. The bending has the silver ontact *2*. The slotted guiding plate completes the turn at the moment when the shutter blades are ompletely open (see p.46). Remember that during the shutter winding the slotted guiding plate is mmobile; therefore, the electric circuit does not close and the lamp does not flash. If the flash ynchronization is malfunctioning, check the flash socket *3* and the contact spring *1*.

Some "Moscow-4" camera modifications have a slightly different contact mechanism. The lotted guiding plate *5* is same as in the "Moscow-2" camera (Fig.36c). The circuit is closed by a mall lever with the bending and the contact turned by the slotted guiding plate *5*. This lever is eturned to the starting position by a spring.



igure 47. The "Moscow-4" camera parts:
- lens with a shutter; b - the flash synchronization mechanism.

Device for Making 6 x 6 cm Negatives

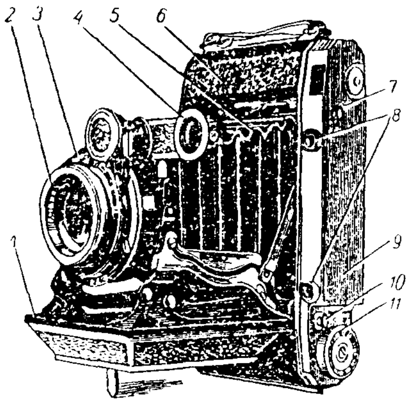


Figure 48. The "Moscow-5" camera.

The back plate is equipped with an additional inspection window for making 6x6 cm negatives. A 6x6 cm metal frame is installed inside the focal plane. The viewfinder has a shifting frame for this format which can be installed quickly.

"MOSCOW-5"

The "Moscow-5" camera is an improved modification of the "Moscow-4" camera. It has a sturdier, more durable body molded under pressure, with a removable back cover. The viewfinder is convenient and ready for operation at all times.

The "Moscow-5" camera has a faster lens with a horter focus. The shutter is equipped with a selftimer.

The design of the lens, body, and other units is similar to that of the "Moscow-2" camera (see p.40).

Major Camera Assemblies and Parts

The camera consists of the front plate *1* (Fig.48), lens *2*, shutter *3*, rangefinder compensator *4*, bellows *5*, body *6*, lock knob *7*, rangefinder front protective glass *8*, top shield *9*, release button *10*, and film rewind handle *11*.

Top Shield

The top shield *9* covers the film release and the interlocking mechanism, the rangefinder prism and the optical viewfinder.

The film transport and the interlocking mechanism *1* (Fig.49) are the same as in the "Moscow-2" camera. The positions of the rangefinder prism *2* and, consequently, the viewing eyepiece were modified. The viewfinder design was changed entirely.

The top shield is removed as follows. Unscrew the screw and remove the handle *11* (Fig.48), remove the rangefinder protective glass 8 and the back eyepiece screwed in the threaded hole *3* (Fig.49).

Selftimer

The "Moment-24C" diaphragm inter-lens shutter of the "Moscow-5" camera has a selftimer mechanism in addition to the automatic shutter speeds and the flash synchronization mechanism. A delay mechanism similar to the shutter delay unit works as a selftimer mechanism.

The selftimer delay mechanism *1* (Fig.50) is fastened with two screws to the interior shutter body. The figured head of one of them holds the end of the shutter working spring *6*. The selftimer operation principle is the following. While it winds the ring *7*, the hook *3* positioned on it catches one of three shoulders on the shaft of the delay mechanism's first and largest gear *2*

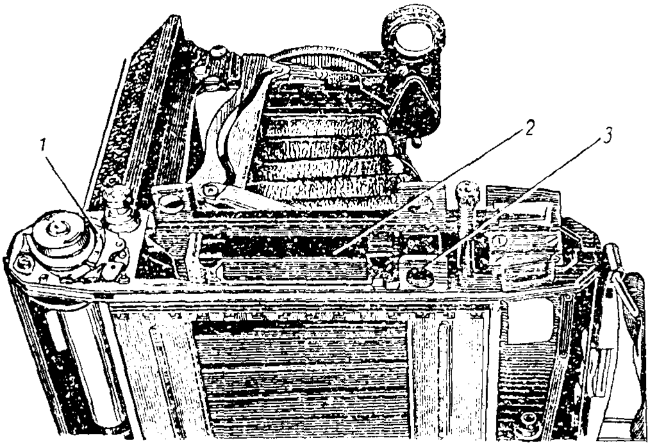


Figure 49. The location of the parts under the top shield of the "Moscow-5" camera.

(Fig.50 shows the position of the hook *3* at the reset shutter). The positions of the hook and other parts on the removed ring are shown on Figure 51b.

When the release lever *8* (Fig.50) is pushed, the ring *7*, driven by the spring *6*, rushes forward and activates the gears and the pallet of the delay mechanism. After 10-15 seconds of the

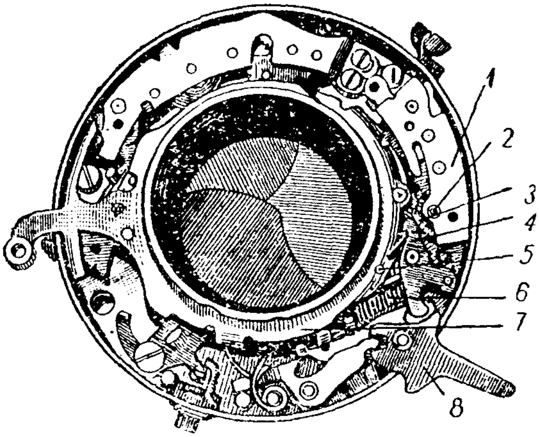


Figure 50. The "Moment-24C" shutter mechanism.

delay mechanism's operation, the gear *2* shoulder turns far enough to free the hook *3* and to let the ring *7* continue to move; the shutter snaps into action.

Selftimer malfunctions. 1. ***After pushing the release lever, the delay mechanism either does not work or works sporadically.*** This most common selftimer malfunction is caused by dirty or poorly linked gears in the delay mechanism. Therefore, the mechanism should be removed by freeing the spring *6* and removing the ring *7*. Then it must be completely immersed in benzine and brushed. Mechanism disassembly is complex so try to clean it without disassembly (it is possible in most cases). After you have cleaned the gear shafts and pallet, oil them slightly (see p.38) and check how well the mechanism operates by turning the first large gear *2* with your finger.

If after such cleaning the mechanism is still not working, it has to be disassembled and each part has to be cleaned separately. Before disassembling, study the mechanism carefully or, better yet, sketch the position of the delay mechanism parts.

2. ***After pushing the release lever the delay mechanism does not work and the ring 7 moves freely.*** This problem is caused by the hook *3* being broken. Make a new hook.

3. ***After the selftimer delay mechanism trips, the ring 7 (Fig.50) stops, and the shutter does not work.*** To find and fix this problem, you have to know the function of the pin *5* on the ing *7*. The ring has two ledges in front of the pin, and during the winding of the shutter, the pawl *4* hooks them. When the shutter is working without the selftimer, the pawl hooks the first ledge; when it is working with the selftimer, the pawl hooks the second ledge.

The spring presses the pawl *4* to the ring *7*. Consider a situation when the ring is set for hutter operation with the selftimer, and the pawl is hooked to the second ledge (see Fig.50).

After the release lever *8* is pushed, the delay mechanism *1* starts working, and the ring slowly moves driven by the spring *6*. When the first ledge reaches the pawl, they get hooked, and the ring *7* stops. To prevent this, the ring has a pin *5*, and the pawl *4* has a small spring. When the ring is moving, its pin reaches the spring on the pawl and turns it a little so that the pawl does not hook the ledge on the ring. Thus, the problem has to be sought in one of the above mentioned parts. Pay particular attention to the spring of the pawl *4*.

Lens

The "Moscow-5" camera has the "Industar-24" lens; it is a four element anastigmat with coated optics. Its design is similar to the "Industar-23" (see p.52).

Specifications

Focal length	105 mm
Relative aperture	1:3.5
Field angle	52°
Distance scale range	from 1.5 m to ∞

"LUBITEL", "LUBITEL-2", AND "SPUTNIK" CAMERAS

The described group includes twin lens reflex cameras (see p.22) with a 6x6 cm frame. They have a simple design and are easy to operate. A plastic body makes the cameras light.

The "Lubitel" and "Smena" camera types have shutters of similar design. Thus, the design and repair are included in the description of the "Smena" camera line. The difference is in the method of fastening to the body and in the position of the lens diaphragm. In the "Smena" cameras, the diaphragm is located inside the lens block, and in the "Lubitel" cameras it is inside the shutter.

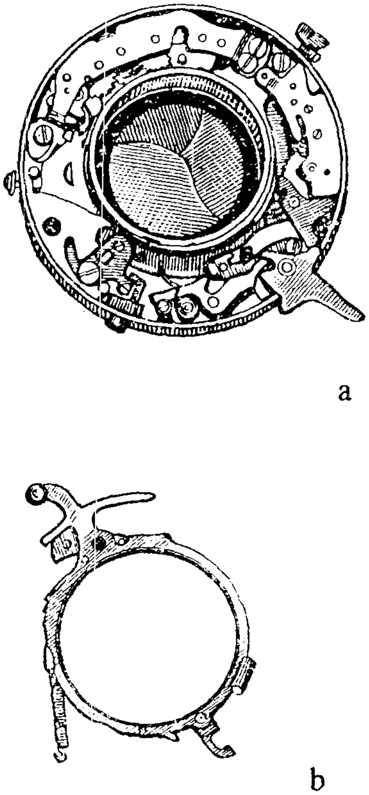


Figure 51. The"Moment-24C" shutter mechanism with the winding ring removed.

"LUBITEL"

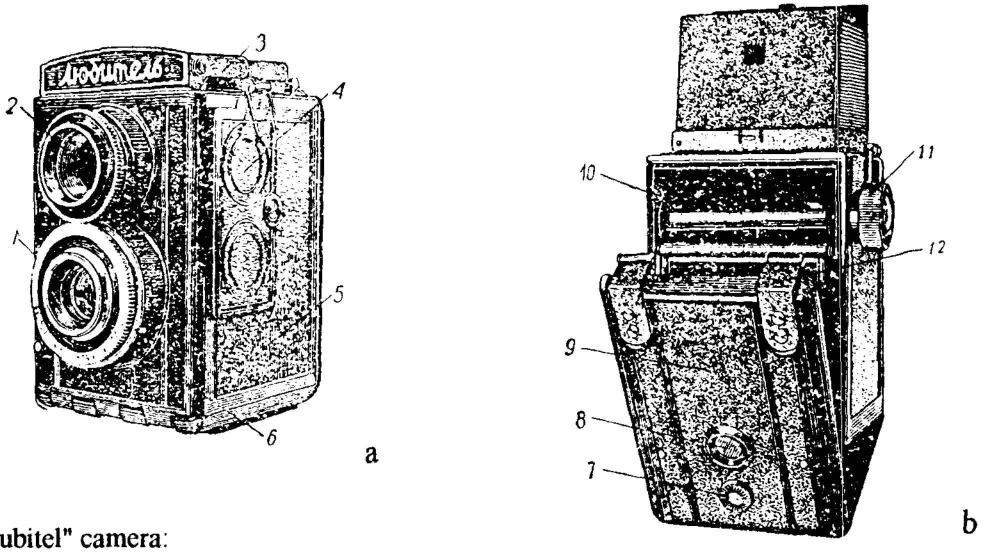
Major Camera Assemblies and Parts

The camera consists of the objective lens *1* (Fig.52a), viewfinder lens *2*, waist-level viewfinder *3*, compartment for filters storage *4*, body *5*, shutter *6*, inspection window cover *7*, inspection window *8*, rear angled cover plate *9*, spool holder *10*, film transport knob *11*, and locks *12*.

Camera Body and Back Cover

The "Lubitel" camera body has a rigid construction. It supports all the parts and semblies of the camera. During disassembly and reassembly, special care should be taken when rewing the parts' fastening screws because the thread in the plastic body can easily be damaged.

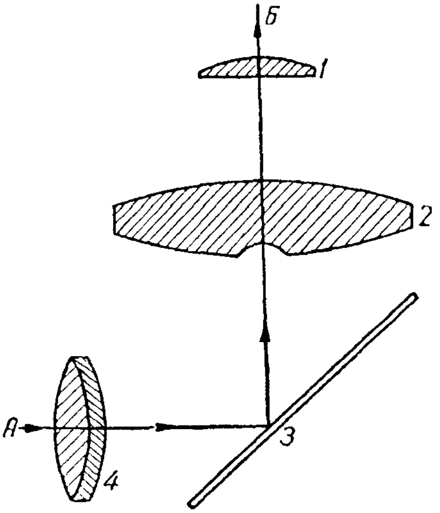
Two spring locks are located on the back cover. They commonly weaken, and then the ck cover is poorly fixed in the closed position. To fix the locks, bend down the springs very refully using pliers because they can easily be broken off.



gure 52. The "Lubitel" camera:
the front view; b - the rear view.

For advancing the film, the film transport knob *11* (Fig.52b) is mounted on the body. side, on its shaft, there is a brake spring allowing only clockwise rotation of the knob. If it is le to turn in both directions, it means that the end of the brake spring has broken off. To fix the spring, remove the knob and make a new 3 mm bending on the end of the spring. The shaft of the knob should be regularly lubricated. The knob itself is fastened on the shaft with a screw. Make sure that it is tightened at all times because if it becomes loose, the figured hole inside knob becomes damaged.

To make film advancing easier, there are two rollers on the focal frame inside the body. The roller shafts commonly become worn out or broken, and their repair is described on p. 251.



gure 53. An optical diagram of the viewfinder.

Optical and Frame Viewfinders

The "Lubitel" camera is equipped with optical and frame viewfinders (sports finder).

The optical viewfinder (Fig.53) consists of the viewfinder lens *4*, magnifier *1*, collective lens element *2* the mirror *3*. The AB line indicates the light beams' direction.

The magnifier attached to the interior surface of the waist-level viewfinder plate simplifies the focusing. To prepare the magnifier for operation, shift it from the plate and set it in parallel with the collective lens element. The collective lens element has a small ground glass area inside it used for focusing. The mirror is firmly affixed. The viewfinder lens consists of an achromatic lens element with a relative aperture of 1:2.8. A significantly larger relative aperture of the viewfinder lens compared to the objective lens makes focusing easier. The viewfinder lens is placed in the mount with the multi-entry thread screwed in the camera body.

The camera's viewfinder design allows focusing to be done with good precision and the object to be seen before and during shooting. The mirror on the way of the light beam reflects it toward the collective lens element used for focusing and finding the view. The viewfinder lens rotating on the thread is coupled with the objective lens.

The waist-level viewfinder contains metal light-blocking covers which, together with the top cover, form the waist-level viewfinder hood. This viewfinder hood consists of the base with three side plate covers attached to it and the top cover. Each cover and the top cover turn around the shaft with the spiral spring in the center; this spring sets the covers and top cover in a vertical position. The setting magnifier is attached to the top cover.

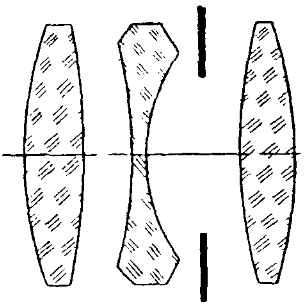


Figure 54. An optical diagram of the T-22 lens.

Frame viewfinder consists of the waist-level viewfinder hood *3* parts (Fig.52), i.e., the front frame and the rear light-protective plate with an inspection window. The top cover has a shield turning on a shaft. If the shield is tilted, it will hook a shoulder on the rear plate. The base of the waist-level viewfinder hood is fastened with three screws to the camera body. To remove the waist-level viewfinder, just slightly untighten the screws and shift the waist-level viewfinder hood a little until the screw heads coincide with the figured cuts on the hood base.

The hood is closed as follows. First the setting magnifier is removed, then the side covers, rear cover and the top cover which snaps to the hood base lug with its shoulder. To ensure that the waist-level finder opens easily and the cover is set precisely in the vertical position and remains undeformed, it is necessary to follow the described closing sequence carefully. Do not forget to regularly lubricate the shafts and springs of the covers.

If a cover or the top cover is deformed, remove the hood and take out the cover shaft. To do that, push the cover shaft from one end with something sharp (say, an awl) and pull it from the other end with pliers; hold the spiral spring of the cover so it does not fall out.

Before disassembly, study the spring position carefully to be able to reinstall it. Sometimes the end of the spring breaks off and the plate sinks down. To fix the spring, unwind one or two coils on the broken end, straighten them, and shape as necessary.

The "Lubitel" camera is equipped with the T-22 lens (a three component anastigmat); ts speed and image sharpness yields good picture quality. The lens' optical diagram is shown on igure 54.

Specifications

Focal length	75 mm
Relative aperture	1:4.5
Field angle	60°
Scale of the relative apertures	1:4.5; 1:5.6; 1:8; 1:11; 1:16; 1:22
Distance scale range	from 1.3 m to ∞
Resolution in lines per 1 mm:	
in field center	28
on field edges	12

Lens design and disassembly. The T-22 lens is installed in the leaf shutter mount. The ont lens element can move, and the other two are fixed. Focusing is done by the front lens lement. The lens optics are not coated.

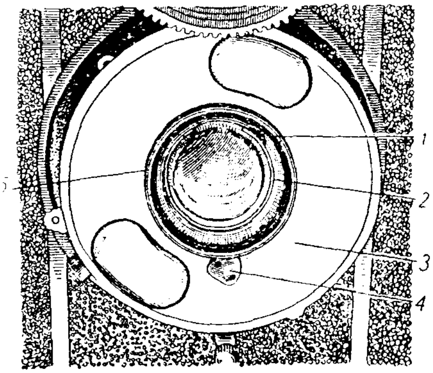


Figure 55. The shutter and the second lens element

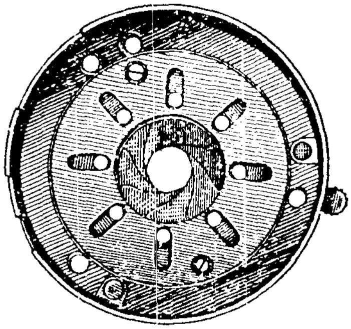


Figure 56. The diaphragm.

The front lens element mount has an exterior multi-entry thread to secure it in the camera ody. The second lens element is fastened with the ring spring *2* (Fig.55) inside the body.

The third lens element is secured with a ring spring in the back of the shutter. To take out ie lens element, remove the ring spring from the body through a special recess *1*.

Diaphragm. The iris lens diaphragm (see p.33) is located inside the shutter between the econd and the third lens elements. The diaphragm (Fig.56) consists of ten blades and a crown onnected to a tang. Diaphragm breakage is very rare. To disassemble the diaphragm, it is first ecessary to completely disassemble the shutter.

Shutter

The "Lubitel" camera is equipped with a diaphragm inter-lens shutter with advance winding for all speeds.

To remove the shutter from the body, unscrew the fastening nut located inside the camera body with the key. (The fastening nut becomes visible when the back cover is open.) The shutter with the lens is removed only when the blades of the shutter or of the diaphragm do not function, or in other equally extraordinary cases. All the other malfunctions can be eliminated without shutter removal.

Partial shutter disassembly is accomplished as follows. Set the objective lens in the ∞ position (at this time the viewfinder lens sets itself in the ∞ position as well), then remove toothed lens mount by unscrewing the three set screws. Make a mark on the top of the front lens element mount, and slowly unscrew the mount while counting the turns run by the mark until the mount comes off. It is also important to register the position of the mark at the time when the mount is taken off to be able to reinstall it (the thread is multi-entry) and to avoid lens adjustment.

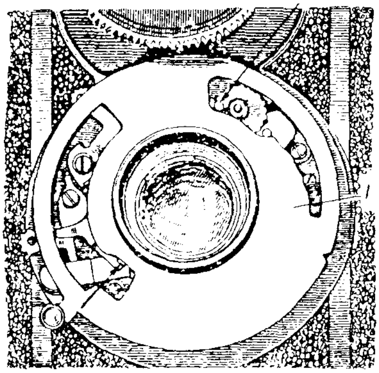


Figure 57. The shutter speed setting ring.

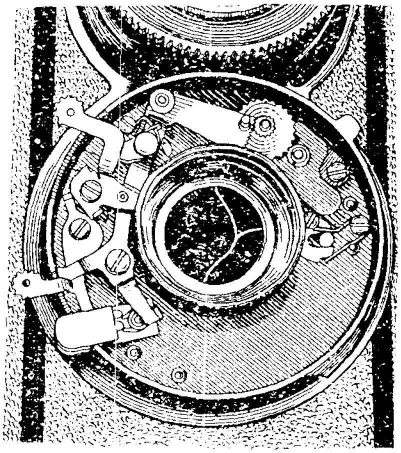


Figure 58. The shutter mechanism.

After the front lens element mount is removed, take down the plate *3* (Fig.55). To do that, turn the lock *4* with a key or tweezers. Then turn the plate *3* by 10-15° until its guides coincide with the grooves on shutter base shaft journal *5*, and remove the plate. The shutter speed ring *1* (Fig.57) is placed underneath the plate. When reinstalling the ring *1*, it is important to correctly position the segment gear pin of the shutter speed mechanism (see upper arrow) and the speed "B" lever bending (see lower arrow). These parts can be seen well on Figure 58 where the shutter mechanism is shown without the shutter speed ring.

For all other problems pertaining to shutter design and repair refer to p.77.

The "Lubitel" camera adjustment is done in two stages: body and objective lens adjustment and body and viewfinder lens adjustment. Each lens is adjusted separately and then coupled by toothed mounts.

The viewfinder lens misadjustment is much less common than that of the objective lens. The objective lens misadjustment is mostly caused by the loosening of the set screws on the toothed mount or by disassembly involved in the repair of the shutter.

First of all, unscrew the set screws and remove the toothed mount from the objective lens. Do not take out the viewfinder lens mount. Check the viewfinder lens adjustment. To do that, focus the camera on an infinitely distant object (a mast or tower 100 m away) and check the image sharpness on the ground glass of the viewfinder's collective lens element. At this time, the viewfinder lens should be in the ∞ position (the ∞ sign on the lens rim has to be opposite the arrow).

If the viewfinder lens does not show the required image sharpness, set the mount in the ∞ position, loosen the set screw on the toothed mount, and while holding the mount in your left hand, turn the lens with your right hand until you get a sharp image of the infinitely distant object.

If the viewfinder lens adjustment is in order, check and adjust the objective lens. To do that, set the "B" shutter speed, depress the shutter release lever with your left index finger and hold the shutter open. Support the ground glass in the focal frame with your thumb. The ground glass surface should be facing the lens. Point the camera at an infinitely distant object and (slightly) turn the front lens element mount in the opposite direction with your right hand until you get a sharp image of the infinitely distant object on the ground glass. Then, replace the toothed mount and tighten the set screws. Before reinstalling the toothed mount, set the viewfinder lens mount in the ∞ position as well.

Now is the time to check the rotation of the toothed mounts. If the teeth are linked very tightly and rotation is hard, slide the objective lens down, inserting a screwdriver between the shutter and the front body panel. If the link is loose, slide the shutter up the same way.

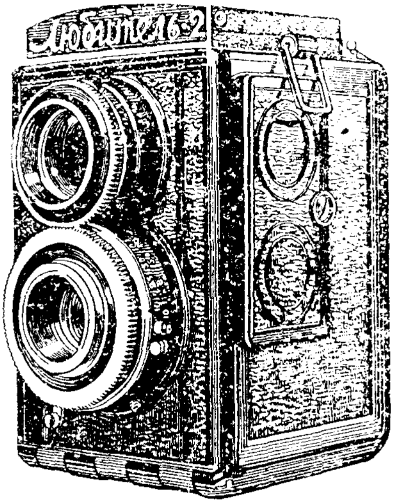


Figure 59. The "Lubitel-2" camera.

"LUBITEL-2"

The second modification of the "Lubitel" camera (Fig.59) has a flash synchronization mechanism and an automatic shutter release (selftimer) mechanism built into the shutter. These mechanisms are similar to those in the "Smena-2" camera (see p.83). The repair of all the other "Lubitel-2" camera units is done the same way as for "Lubitel".

"SPUTNIK"

The "Sputnik" camera is a part of a stereo set and serves for producing stereoscopic images.

The stereo effect, i.e., 3D-effect, is achieved by taking pictures of the object from two points separated by an interval equal to the distance between human eyes (65-70 mm).

We perceive objects as 3-dimensional because we have two eyes. One eye only gives a view of the objects in one plane. The same is true for the cameras with one lens.

The stereoscopic camera is equipped with two lenses which afford two simultaneous images of one object to achieve the stereo effect.

The "Sputnik" stereo camera is in fact two "Lubitel" cameras placed next to each other and sharing a common viewfinder. The distance between the objective lenses is 65 mm. This interval is called the stereo basis.

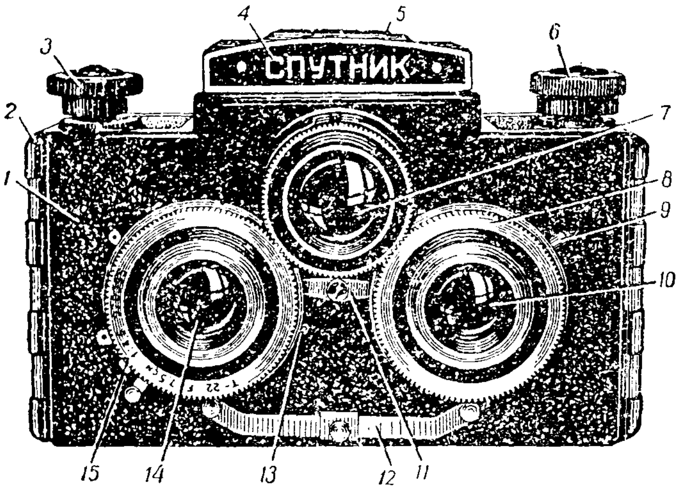


Figure 60. The "Sputnik" camera.

The "Sputnik" camera operates with the standard 60 mm wide roll film (size 120). One film load yields 6 stereo images or 12 regular pictures.

Technical and photographic characteristics are the same as for the "Lubitel" camera.

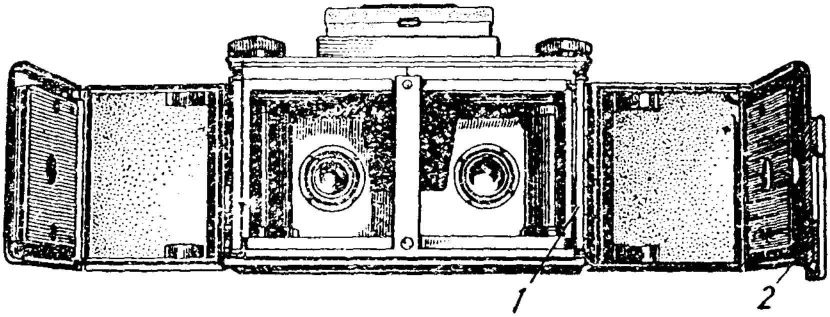
Major Camera Assemblies and Parts

The "Sputnik" camera consists of the body *1* (Fig.60), angled back covers *2*, film spool fastening knob *3*, waist-level viewfinder hood *4*, sports viewfinder *5*, film rewind knob *6*, viewfinder lens *7*, right shutter *8*, flash socket *9*, right objective lens *10*, connection lever *11*, diaphragm adjustment lever *12*, selftimer lever *13*, left objective lens *14*, and left shutter *15*.

Camera Body and Angled Back Covers

Its plastic body and back covers (Fig.61) significantly reduce the weight of the camera, but also make it less sturdy. The body supports all the camera parts. Some sets of parts serves for loading and transporting the film. A spool of film goes to the socket on the right side of the body, and the take-up spool goes to the left. To load a spool of film, lift the film spool fastening knob *3* (Fig.60) which can turn freely in any direction. The knob consists of a head, a shaft, a spiral spring, and a fastening screw. The base of the head is secured with three screws to the camera body.

To install the take-up spool, lift the film transport knob *6* (it turns clockwise only). The rewinding mechanism includes the base, the knob, the shaft with a cross-piece, the brake spring,



igure 61. The "Sputnik" camera interior view.

nd the fastening screw. The brake spring can be seen if the knob *6* is lifted. Its upper bent end nters the knob's groove. If the end has broken off, take the spring out and make a new bending. fter extensive camera use the roller shafts *1* (Fig.61) wear out. See p. 251 for the information n how to repair them.

Camera Shutters

The camera has two coupled shutters (Fig.62) similar in design and repair to the Smena-2" camera shutter. All parts and subassemblies are associated with the left shutter; the ight shutter has only the flash socket and the mechanism *1* in the place where the left shutter has onnecting lever *4*. It freely turns on the shaft and connects the ring-links of both shutters.

The left shutter ring-link is returned to the original position by the spring located on the hutter base (it is covered by the connecting lever). The first shutter ring-link is returned to the riginal position by the flash synchronization post spring attached to its shaft.

Shutter disassembly and reassembly is the same as for the "Lubitel" camera. However, you ould find out which one is malfunctioning before disassembling them. More often than not it is e left one. Before you start disassembling, remove both exterior toothed rings and mark them, nd the viewfinder ring accordingly. Each ring is fastened with three set screws. Do not remove e viewfinder ring. Open the locks and remove the shields, setting ring with left shutter lever and ght shutter regular ring. Both shutters are now open (see Figure 62).

Remove the connecting lever *4*, swiveling on the screw *2*, and separate the shutters. Now each shutter can be checked. Wind the left shutter and check the operation of all of its parts(see the "Smena" camera); the right shutter is checked by turning the ring-link: it should be able to return to the starting position. Finally the malfunctioning shutter should be removed for repair.

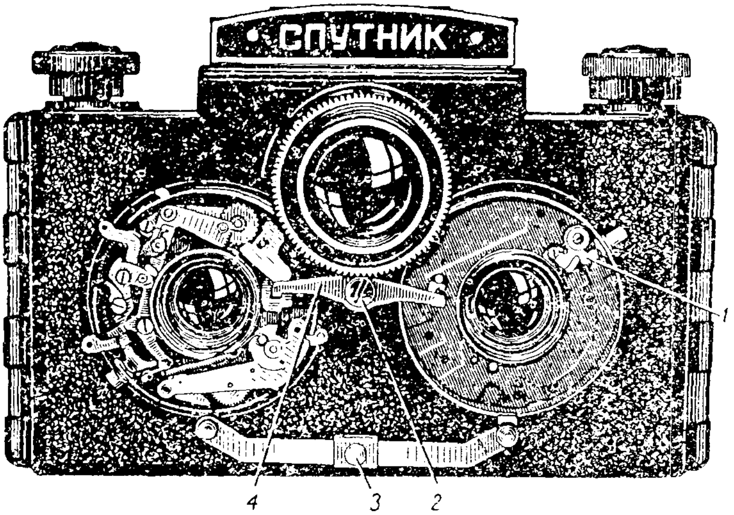


Figure 62. The mechanism of the shutters.

Each shutter is fastened to the camera body from the inside with a nut. The nut should be unscrewed only with a key. To separate the shutter diaphragm levers, remove the handle *3*.

Viewfinder's Well, Viewfinder, Lenses, and Their Adjustment

The "Sputnik" camera viewfinder's hood and viewfinder are the same as in "Lubitel". The T-22 photo lenses are coated. They have 75 mm focal length, and their design is similar to that of "Lubitel" camera lens.

The viewfinder and the objective lenses are coupled by the exterior toothed rings adjusted in the same manner as in the "Lubitel" camera. But in the "Lubitel" camera, the viewfinder lens and one objective lens should first be reinstalled correctly, and only then do the connecting rings have to be put back; in the "Sputnik" camera the viewfinder lens and two objective lenses have to be reinstalled. It is recommended to adjust the viewfinder lens first, to put the front toothed ring on its mount and fasten it, and then to adjust both objective lenses.

"ESTAFETA" CAMERA

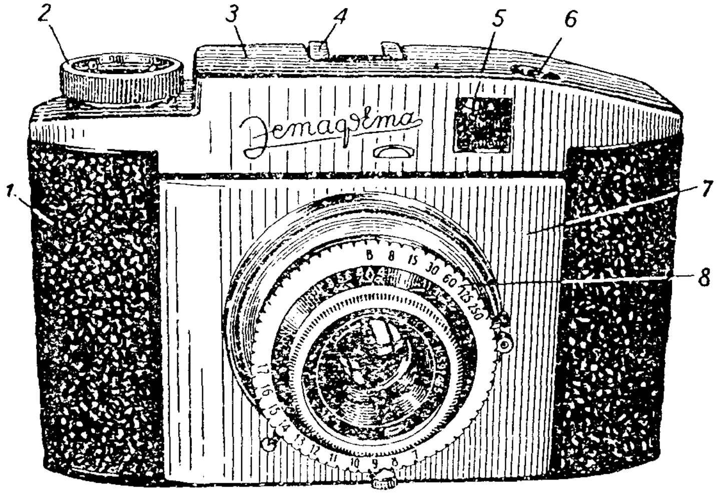
The "Estafeta" is a roll film (medium format) camera with a telescopic barrel. The frame size is 6x6 cm. "Estafeta" is one of the simplest cameras as far as its design goes. Most of the "Estafeta" camera subassemblies and mechanisms are similar to those in the "Smena" camera. Keeping in mind that the "Smena" camera is described in great detail in this book, we will only consider subassemblies that are not found in the "Smena" camera.

Major Camera Assemblies and Parts

The camera consists of the body *1* (Fig.63), film transport knob *2*, top plate *3*, accessory ıoe *4*, viewfinder front lens element *5*, barrel lock button *6*, front plate *7*, and shutter *8*.

Camera Disassembly and Reassembly

Most of the "Estafeta" camera malfunctions can be fixed without disassembling it. If ımera disassembly is necessary, remove the film transport knob *2* first, followed by the top plate The knob is screwed on shaft with left hand thread and should be unscrewed turning it to the ght. The knob itself cannot turn to the right because of the brake spring underneath. You must, erefore, remove the fork while holding the knob. The fork shaft is made of brittle metal. Thus, it recommended, before unscrewing, to take off the film type reminder scale fastened with a cut ıg, to oil the fork shaft thread, and to start unscrewing only in 2-3 hours. After the knob is taken f, remove the plate fastening screw (it is located under the handle), the viewfinder eyepiece *2* ig.64), and the top plate.



gure 63. The "Estafeta" camera.

To remove the front plate *7* (Fig.63), unscrew the nut *3* (Fig.64), remove the shutter, the rews *2* and *3* (Fig.65), and the two identical screws on the opposite side of the bottom of the ıdy. There is a felt shim under the plate which also has to be removed. The body's front plate is cured with four screws; they should be removed carefully because they are pushed by two latively strong springs.

Film Track and Film Transport

When rewound from one spool to the other, the film travels over two rollers, *1* and *4* ig.64). Quite often the roller shafts wear out and fall off. The lower roller shaft is a part of the ller, and the upper shaft is screwed on the thread in the body. To get the roller out, remove the p plate *3* (Fig.63) and unscrew the screws *1* and *4* (Fig.65).

The film transport knob *2* (Fig.63) turns clockwise only. To prevent it from turning in the opposite direction, the brake spring is installed. Its design and repair are described on p.74.

Lens Barrel

For minimizing the camera's size, the barrel is designed to be telescopic. It has to be set for operation. It is driven by two springs. This device rarely breaks. To remove the barrel, take off the front plate *7* (Fig.63) and the body front plate installed under the plate.

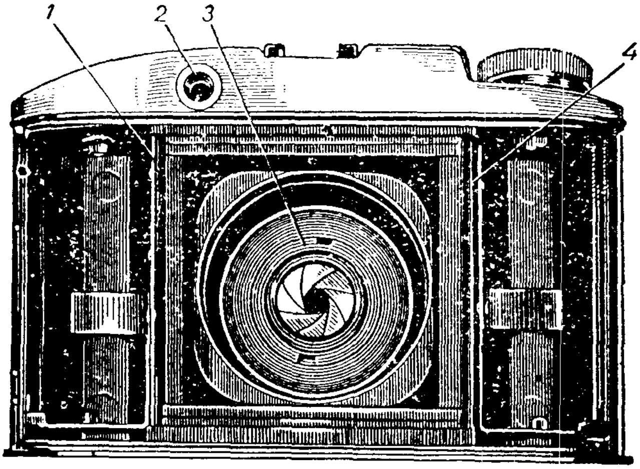


Figure 64. The "Estafeta" camera film track.

In both the open and close positions, the barrel is locked with a moveable frame which drops at the touch of the button *6*. This button is connected with the frame by a rod. The spiral spring inside the body sends the frame to the starting position.

Shutter

The "Estafeta" shutter is almost an exact replica of the shutter in "Smena" and "Smena-2" (see p.77). One difference is that the "Smena" shutter has three blades and "Estafeta" has four.

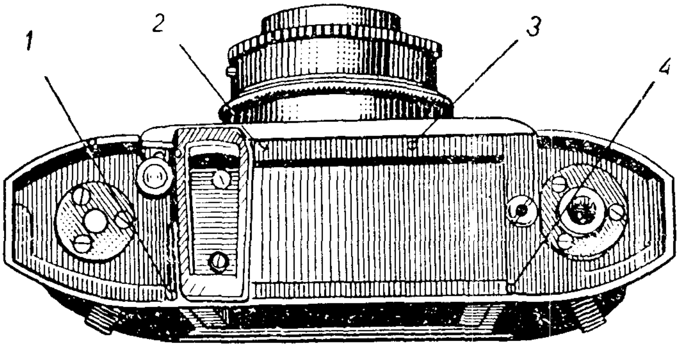


Figure 65. The "Estafeta" camera without the top plate.

The front part disassembly sequence is also different in the two brands.

The shutter front part is disassembled as follows. Set the front lens element mount in the ∞ position. Unscrew the three set screws in the front lens element mount and remove the mount. Mark the front lens element rim, unscrew the rim, and count the turns; note the position of the mark on the unscrewed rim. The marking is done for future reassembly when you will have to start in the right position and choose the right thread entry. Unscrew one fixing screw in one of the three holes in the front black plates. The screw's head is in one of the semicircular holes in the mount. There is a thread inside the mount which holds the front lens element rim. Having unscrewed the screw, take off the rim with the aid of a key (see Fig.25). Now all the other parts can be removed. To remove the shutter from the camera, unscrew the nut 3 (Fig. 64).

Lens and Its Adjustment

The "T-35" lens is a three component coated anastigmat. The lens optical diagram is shown in Figure 54. The front lens element mount is moveable, but the second and third lens elements are fixed. The lens and body adjustment is done with the moveable front lens element (see p.67).

"SMENA", "SMENA-2", "SMENA-3", "SMENA-4", "SMENA-5", "SMENA-6", "SMENA-M", "SMENA-2M", AND "VESNA" CAMERAS

Cameras of this group are all similar. They all have a plastic rigid body which significantly reduces their weight. A removable back cover makes the cameras convenient for loading and lens adjustment. The film is transported from one cartridge to another making it possible to take out part of the exposed film.

The "Smena" camera was the first one designed in this group whereas all the others were improved models of this camera.

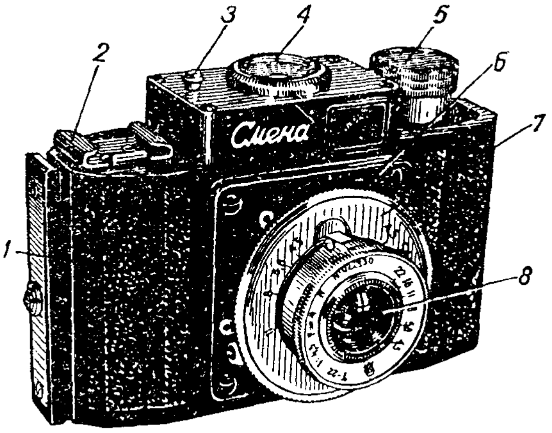


Figure 66. The "Smena" camera.

The "Smena" camera's major units, the shutter and the lens, were kept unchanged despite all other modifications. Therefore, "Smena" is described in the greatest detail.

After the "Smena" camera was discontinued and replaced with "Smena-2", "Smena-3", "Smena-4", etc., a "Smena" camera of a somewhat different design was manufactured again. The only changed unit was the shutter release mechanism, identical in design to that of the "Smena-3" camera (see p.87). In addition, the new "Smena" is equipped with a flash synchronization mechanism. Thus, if you should discover some discrepancies in the description of the "Smena" camera and your actual camera, it means that you have a "Smena" with a new design. The difference in appearance is that the new "Smena" has a black lens rim *6* (see Fig.72) and a black front plate *5*.

"SMENA"

Major Camera Assemblies and Parts

The camera consists of the body *1* (Fig.66), accessory shoe *2*, release button *3*, exposure counter *4*, film transport knob *5*, lens panel *6*, shutter *7*, and lens *8*.

Camera Body and Back Cover

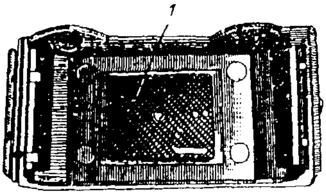


Figure 67. The back cover.

The plastic body and the back cover break easily when the camera falls. The screws should be screwed in the body slowly and carefully because the thread in the plastic can easily be damaged.

The plate *1* fastened to the back cover (Fig.67) flattens the film in the film track. This plate is attached to a spring located underneath it, and the spring is riveted to the back cover. If the spring has to be secured on the back cover, it can easily be done, but the cover should not be hit too hard. The old rivet has to be drilled out.

Viewfinder

The viewfinder consists of two lenses: the lens *1* (see Fig.70) and the mounted lens element *12* (the eyepiece). The eyepiece is screwed in the body, whereas the lens is glued with shellac.

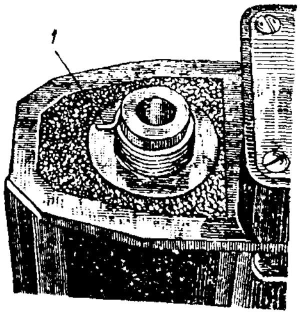


Figure 68. The brake spring.

Film Transport Knob

The film transport knob *5* (Fig.66) pulls the rewounded film from one cartridge to another. The film is advanced by one frame only. Its motion is controlled by a special mechanism activated by film perforation that drives the sprocket *4* (Fig.69).

Bicapped metal cartridges are used in the "Smena" camera. If the film is pulled with difficulty, and the photographer continues turning the handle *5* (Fig.66), unaware that the film has stopped, this can break the film perforation and damage the shaft thread. This shaft bears the sprocket *4* (Fig.69) and the exposure counter gears. It seems clear that the cartridges should be selected thoroughly so that they allow the film to advance without considerable effort (see p.17).

The film transport knob *5* (Fig.66) should be turned clockwise only. The brake spiral spring *1* (Fig.68) inside the knob has a bent end. This bent end enters a hole in the knob and prevents it from rotating counter-clockwise. If the knob is able to turn in either direction, this means that the spring's bent end has broken off. To fix the spring, remove it and make a new bend about 3 mm long. Before doing that, it is necessary to remove the knob screwed on the rewinding fork shaft. Hold the knob and unscrew the fork with pliers.

Exposure Counter and Start Mechanism

When the film is rewound to the next frame, the exposure counter limb advances one point relative to the index on the protective glass. The film advances by one frame only.

The operation of the exposure counter and film release is controlled by a special mechanism. To understand the design and operational principle of this mechanism, unscrew the four screws *1* (Fig.69) and remove the shield *2* (the exposure counter assembly) with the release button *3*. Then remove the button *3*, while holding its shaft with pliers, and put it back without the shield as shown in Figure 70. The spiral spring *8* (Fig.70) and the pin *7* are on the rod. The rod enters the hole *1* (Fig.71), and the long end of the pin goes into the groove *2*.

During the movement of the film, the perforations rotate the sprocket *4* (Fig.69) screwed on the shaft *4* (Fig.70) which holds the gear *8* and the wheel *5* with the notch *11* and the pin *3*.

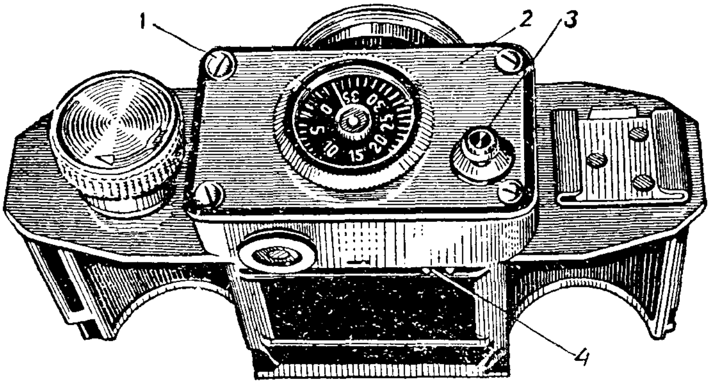


Figure 69. The interior view of the camera body.

When the gear *9* makes one turn, the pin *3* reaches the pin *7* and stops the rotation of the wheel *5*. But the gear and, consequently, the film continue their motion until the pin *10* on the gear reaches the second notch edge *11* on the wheel. The gear *9* turns the exposure counter gear *2* as well.

By pushing the button 6, the film is advanced to the next frame. At this time the button rod goes down, and the pin *7* releases the pin *3*. The wheel *5*, held by the spiral spring on the shaft *4*, returns to the starting position. After that the film is advanced to the next frame.

The start mechanism is disassembled in the following order. Unscrew the four screws *1* (Fig.69) and remove the top plate *2* with the button *3*. Then unscrew the sprocket *4* with the left hand thread turning it to the right. After the sprocket has been removed, take out the shaft *4* (Fig.70) with the gear *9* and the wheel *5*. But before that, remove the exposure counter limb *2* with the shaft and gear. The limb is secured to the shaft with the locking washer.

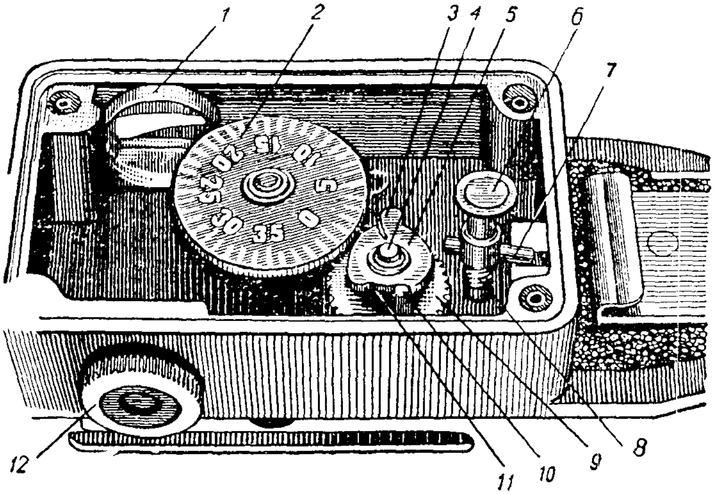


Figure 70. The exposure counter and the film transport mechanism's release button.

Start mechanism malfunctions. 1. ***The pin 10 on the gear 9 has broken off.*** To fix the problem, disassemble the mechanism and remove the shaft *4* with the gear *9*. Then drill out or punch out the rest of the pin, make a new pin, replace it on the gear, and rivet it from the other side. The pin has to be 1-1.5 mm taller than the wheel *5*. The spiral spring above the wheel *5* is hooked to the pin *10* with its one end, and to the pin *3* with the other end. Install the new pin with care while avoiding damage to the gear *9*.

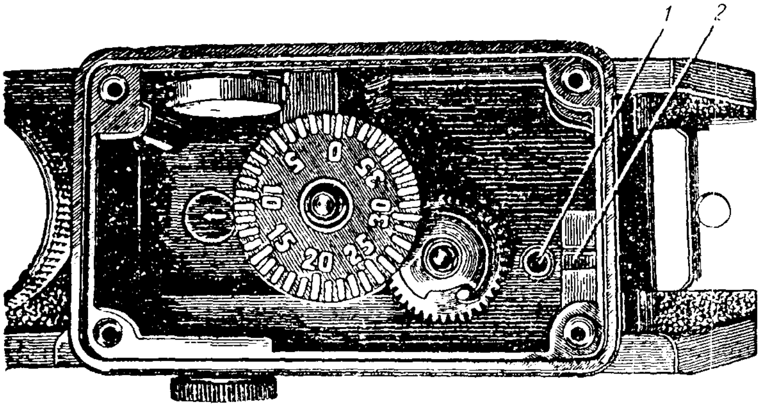


Figure 71. The exposure counter without release button.

2. ***The sprocket 4 (Fig.69) turns, but the mechanism does not function.*** Disassemble and check the threaded hole on the wheel *4* and the shaft *4* (Fig.70). If the wheel *4* (Fig.69) hole became too big, place the sprocket on the hard surface and pull together the hole with the thread using the hammer and the punch rod. Pulling can be done from both sides of the wheel. Then put the wheel back. If this method does not fix the thread, drill a smaller hole and make a new thread.

3. ***After the button 3 (Fig.69) has been pushed, it does not return to the top position, and the mechanism cannot function.*** Clean and lubricate the button shaft and check the condition of spiral spring *8* (Fig.70).

Shutter

"Smena" camera is equipped with a leaf inter-lens shutter with advance winding for all shutter speeds. The shutter has automatic speeds: 1/10, 1/25, 1/50, 1/100, 1/200 sec, and "B" speed - manual.

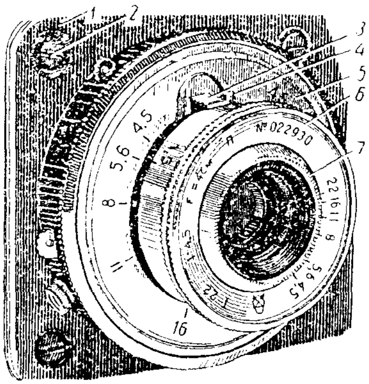


Figure 72. The front plate with the shutter and lens.

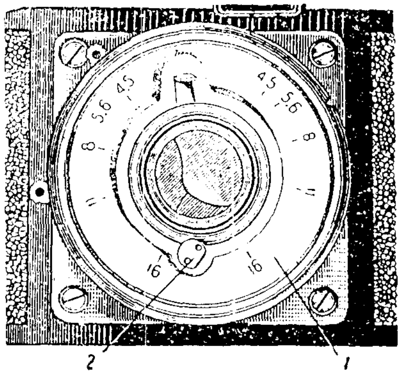


Figure 73. The exterior view of the shutter.

Shutter disassembly. Most repair is done with partial disassembly. Set the lens mount *6* (Fig.72) in the ∞ position, unscrew the three set screws located on its side, and remove the mount. Then mark the lens mount top and slowly unscrew the lens while counting the turns run by this mark. Note the mark position when the lens in unscrewed (see p.81). Then, remove the shutter round plate *1* (Fig.73) by turning the lock disc *2* in any direction and turning the plate 10-15° until its guides coincide with grooves on the shutter base. Now, remove the shutter speed setting ring *1* (Fig.74).

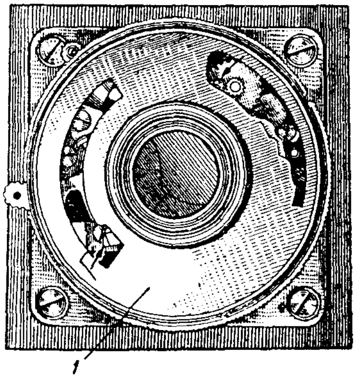
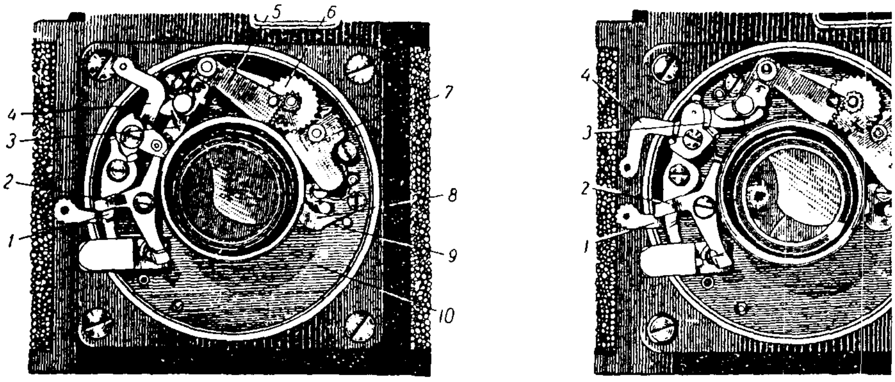


Figure 74. The shutter speed setting ring.

If the shutter has to be disassembled completely, it should be removed from the body. To do that, unscrew the screws *2* (Fig.72) and remove the panel *1* with the shutter. There are three screws on back of the panel; they are holding the shutter on the panel. These screws are also holding the body and the shutter base together. During shutter reassembly, insert its base with blades (Fig.77) into the body (Fig.76) and then position the body against the screw holes in the panel *1* (Fig.72); secure all these parts using the screws.

Major parts and their interaction. The shutter mechanism is contained in the body (Fig.76). When the shutter speed ring is removed, the following parts are seen: the release lever *1* (Fig.75a), speed "B" lever *2*, winding lever *4*, driving lever *3*, and delay mechanism. All of the above mentioned parts are mounted on the base *10*. The part of the ring-link *8* which bears the leaf shutter blades can be seen through the hole in the base. The spring *9* returns the ring-link to the starting position. The Figure also shows the delay mechanism parts: the segment gear *5* with a pin, the escape wheel *6*, and the pallet *7*. The clutch mechanism is fastened with the two screws. The ring-link and the blades are mounted on the back of the base (Fig.77).



a

b

Figure 75. The shutter mechanism:
a- positions of the parts before winding; b - positions of the parts after winding.

All the parts mentioned above are driven by springs made of thin steel wire (string-like). The springs fix the levers before shutter winding and release and return them to the starting position after the mechanism trips. Keep these springs in mind when disassembling and reassembling the shutter.

The lever *1* spring is located on its shaft. One end of this spring is pressed against the lever *2* shaft base and the other (working) is hooked to the lever *1* arm. The lever *2* spring is located on its shaft; one end is pressed against the base shaft *10* and the other is hooked to the lever *2* arm. The lever *4* spring is stronger than all the other springs. It is located on the lever *4* shaft; one end is pressed against the base shaft *10,* and the other is hooked to the handle. The lever *3* spring is a long string wire attached with the same screw as the spring *9*. The segment *5* spring is located on its shaft. One end is hooked to the segment and the other is pressed against the shutter body wall. The segment also has one more lever and a spring; their role will be explained later.

Figure 75a shows the unwound shutter mechanism. When the lever *4* is turned and the shutter is wound, the driving lever *3* turns as well. There is a cut in the lever *3*; it catches the carved tip of the ring-link *8* (there is a lengthwise cut in the shutter base *10* for the ring-link traveling carved tip; it is eclipsed by the lever *5* arm portrayed in the Fig.75a). At the same time the lever *4* hook catches the lever *1* fold and resets the mechanism. The Figure 75b shows the levers in the reset shutter.

When the lever *1* handle is pushed and the shutter is released, the lever *1* releases the lever *2* hook and the latter is driven to turn around its shaft by the wound spring. At the same time, the driving lever *3* connected to it, turns the ring-link to open the shutter blades completely. Each of the three blades is secured with a screw *3* (Fig.77) serving as the blade's shaft. Each blade has a pin *2* entering the ring-link *1* spline. At the slightest turn of the ring-link, the blades turn and open the shutter. The faster the blades turn, the higher the shutter's speed. When the lever *3* (Fig.75) turns, the ring-link drives it all the way to the side, and the blades are able to open completely. The lever then releases the carved tip of the ring-link, and the spring *8* returns it to the starting position. The blades close.

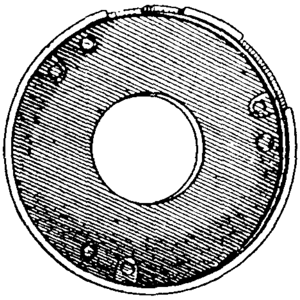


Figure 76. The shutter body.

Shutter speeds are controlled by the delay mechanism and the shutter speed lever *2* (Fig.75a) which are both set in the necessary position with the shutter speed ring *1* (Fig.74).

The lever on the segment gear *5* (see arrow on Fig.75a) is an important part of the delay mechanism. This lever is driven by a spring and can turn only in one direction. When the lever *4* is being wound, its bending touches the segment gear lever that turns and skips the lever *4* bending; the segment gear does not move. When the shutter is released, the lever bending touches the segment gear again, but this time from the other side. In this case the lever turns together with the segment gear *5*, rotating the escape wheel 6 and making the pallet *7* move, which slows down the segment gear. As a result, the segment gear lever slows down the movement of the levers *3* and *4* along with the ring-link and the blades. The more time it takes the segment gear to turn, the longer the shutter blades remain open. Note the shutter speed ring *1* (Fig.74). During the setting of the needed shutter speed, the ring *1* turns, and the pin of the segment gear (see top arrow) stops at a certain step of the ring figured cut. It controls the segment gear's angular turn and, therefore, the automatic shutter speeds.

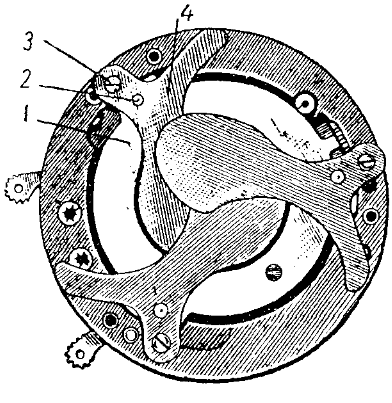


Figure 77. The shutter base and blades.

The "B" speed is controlled by the lever *2* (Fig.75a). At the release of the shutter the lever *4* turns, its bending touches the lever *2* arm, and the lever *4* stops. This happens when the blades are completely open. When the hand stops holding the release lever *1*, this lever returns to the starting position and turns the lever *2* (the spring of the lever *1* is stronger than the spring of the lever *2*). The lever *4* starts moving again, and the blades close. The shutter speed ring *1* (Fig.74) switches the lever *2* from working to non-working mode and vice versa. The bottom arrow on Figure 74 shows the lever *2* bending positioned against a notch in the ring. When the ring *1* turns, the lever *2* bending is drawn out of the ring notch, and this stops short the lever's operation.

During the shutter reassembly make sure that the segment gear *5* pin and the lever *2* bending entered the speed ring holes and were not deformed.

Shutter malfunctions and their elimination. 1. ***The "B" speed is not working.*** The "B" speed does not work when the lever *2* (Fig.75a) is adjusted incorrectly.

Check whether the lever *2* fastening screw is screwed in all the way down; check the lever spring and lubricate its shaft. You may bend the lever *2* arm gently, so at the turn of the lever *1*, the lever *2* would turn far enough for catching and releasing the lever *4*.

2. ***The shutter release lever is pushed, but the shutter does not work.*** Check the delay mechanism. Often the mechanism gears interact poorly as a result of dirt and dried out lubrication. The segment gear *5* (Fig.75a) does not move, obstructs the lever *4* movement, and the shutter does not trip. Take the segment gear *5* pin with tweezers or fingers, and check the segment gear rotation in both directions while watching the pallet. If the delay mechanism is working properly, the segment gear should turn freely and smoothly, and the spring should return it to the starting position.

If the segment gear moves with effort, oil the shafts of the segment gear, escape wheel, and pallet. Turn the segment gear in both directions and check the mechanism's operation once again. If the mechanism is still not working, remove the pallet *7*, and check how the mechanism operates without it. Also check the segment gear spring. The pallet is fastened with a locking washer which is inserted in the shaft groove. Pay attention to the pallet's shaft position on the delay mechanism base . To adjust the interaction of the pallet and the escape wheel, shift the shaft slightly by bending it. Also check and clean the teeth of the segment gear and wheel.

The interaction between the delay mechanism and the lever *4* can be adjusted using the delay mechanism. To do that, with one or two turns loosen the two screws fastening the mechanism to the base, and shift the base a little (the screw holes are somewhat larger than the screws themselves).

3. ***The 1/10 sec speed is not working.*** This speed is controlled by the delay mechanism. The malfunction is eliminated as described in problem No. 2.

4. ***The shutter mechanism trips, but the blades do not open.*** This problem is caused by the lever *3* (Fig.75a) not catching the stamped tip of the ring-link *8* at the release of the shutter.

The lever *3* is pressed to the tip by the spring. Sometimes the spring's end shifts away from the lever *3*, and this lever stops functioning. Check the condition of the spring (it is fastened with the same screw as the spring *9*). The lever *3* spring is very thin and is hard to see. Its shaped tip hooked to the lever *3* is seen first. The lever *3* springs are not identical in different "Smena" modifications. Their descriptions are given along with the specific modification descriptions.

5. ***After the shutter is released, the blades do not close completely, and there is a gap left between them.*** If after the shutter's release, the ring-link *8* (Fig.75a) does not return to its starting position along with the shutter blades, check the condition of the spring *9* that is responsible for returning it. Figure 75a shows the correct position of the spring *9*. If it does not return the ring-link to the starting position, it means that the spring is weak and has to be strengthened by additional bending.

Besides that, the blades may not be able to close completely as a consequence of camera shock and ring-link deformation, and/or loosening of the screws *3* (Fig.77). In that case, disassemble the shutter completely and check the blades and screws holding them.

6. ***Repeated use of the same shutter speed produces negatives of different density.*** This can happen if after the release of the shutter, the segment gear *5* (Fig.75a) does not return to the starting position and, at the next shot, the shutter speed becomes higher. This can be caused by the segment gear spring being displaced and not functioning. In addition, check whether the mechanism fastening screws are tightened and lubricate the shafts of the segment gear, escape wheel, and pallet.

Lens

The "Smena" camera is equipped with the "T-22" lens (Fig.78). Its optical diagram is shown on Figure 54. The lens is positioned in the front part of the shutter; all its lens elements are fixed. The diaphragm is inside the lens.

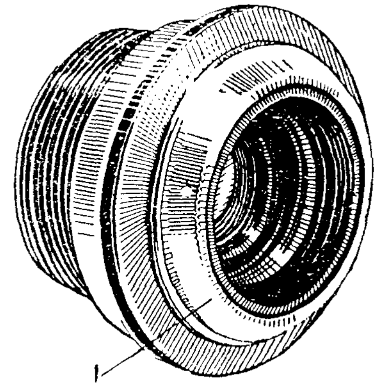


Figure 78. The lens.

Specifications

Focal length	40 mm
Relative aperture	1:4.5
Field of image angle	49°
Scale of relative apertures	4.5; 5.6; 8; 11; 16; 22
Distance scale range	from 1.3 m to ∞
Resolution in lines per 1 mm:	
in field center	28
on field edges	12

The tang *1* (Fig.78) is located on the front of the lens, and it is connected with the diaphragm crown (see p. 33). The tang is not fastened and can easily be removed after taking off the mount *6* (Fig.72).

It is not recommended to disassemble the lens and the diaphragm.

Camera Adjustment

Focusing is done by an axial shift of the entire lens. The distance to the subject is measured by eye. The exterior lens mount has a range scale. In addition, there is a screw on it; this screw confines the mount turning to the range of 1.3 m to ∞. The lens has a large depth of definition. Therefore, small errors in adjustment are barely noticeable.

Misadjustment of the body and lens is uncommon. It could happen as a result of loose set screws fastening the mount *6* (Fig.72). In this case, the mount turns, but the lens does not move.

Besides that, the adjustment of the body and lens can be disturbed by screwing out the lens for shutter repair. The lens mount has a multi-entry thread. During camera assembly by the manufacturer, it does not matter what entry was used for screwing in the lens because the index (red dot) on the diaphragm tang *1* (Fig.78) is put after the adjustment, i.e., after installing the mount *6* (Fig.72) with the diaphragm scale. Unlike the manufacturer, the photographer has to start with the same thread entry as before the disassembly, so that the index on the tang stops opposite the scale. Before disassembling the camera, you should therefore make a mark on the lens mount and count the number of turns as you unscrew it, to be able to start the lens reinstallment with the correct thread entry. This is done to avoid additional adjustment at camera (shutter) reassembly.

The body and lens adjustment is done as follows. Remove the mount *6* (Fig.72), set the "B" speed and open the shutter blades. Place the ground glass in the film plane so it is supported by the film tracks. For better visual control, put in a 4-6 X magnifier.

Point the camera to an infinitely distant subject (a mast or pipe at 100 m distance), and turn the lens mount until the subject image on the ground glass is the sharpest. Then reinstall the mount *6*, so that the set screw *4* is positioned next to the restricting piece *3*, i.e., the ∞ sign is positioned opposite the arrow. If the lens was unscrewed without a mark, try every thread entry until the index on the diaphragm tang stops in the correct position. Usually, this is easily achieved. It is possible to shift the tang by making a new hole in its end for connecting with the diaphragm or by making a new dot (index). However, it takes longer than trying the thread entries.

"SMENA-2"

The "Smena-2" camera (Fig.79) is an improved model of the "Smena" camera. It is equipped with a built in shutter selftimer and a flash synchronization mechanism for the flash. All the other units are the same as in the "Smena" camera.

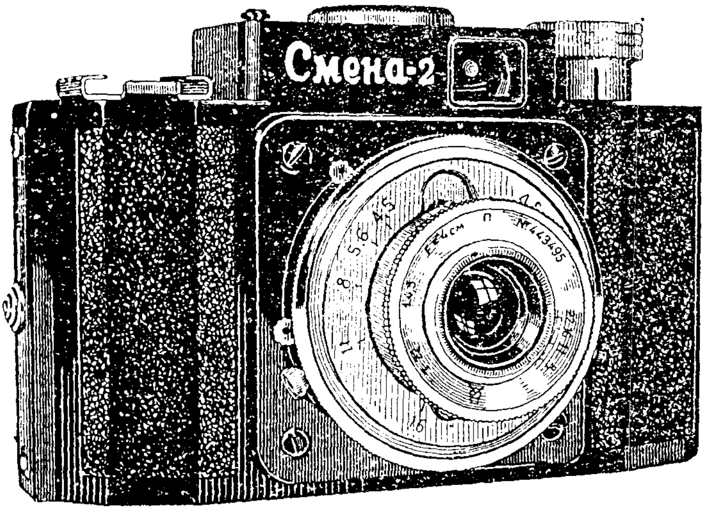


Figure 79. The "Smena-2" camera.

The camera is manufactured at two sites so some minor design discrepancies are possible. For example, one design includes a wire connecting the contact in the camera accessory shoe with a metal tripod nut, and the other one does not.

The selftimer delay mechanism (Fig.80) consists of the segment *8* with the handle *6*, the gear with the clutch device *9*, the gear with the clutch *11*, the escape wheel *12*, and the pallet *13*. All the above mentioned parts are installed on the two plates *14*. The delay mechanism is supported by the shaft *7* which is secured at the shutter base.

Selftimer operational principle. The operation of the shutter mechanism and that of the selftimer are closely interconnected (see p.77).

The selftimer delay mechanism is wound up by turning the handle *6*. The segment *8* turns and winds up the selftimer spring *10*. One end of the spring is attached to the pin on the segment *8* while the other is put on the pin *15*. In addition, at the turn of the handle *6*, the entire delay mechanism turns on the shaft *7*, and the special hook on the mechanism plate is fixed by the shutter hook *16*. When the delay mechanism turns, the long arm of the pallet *13* is pressed against

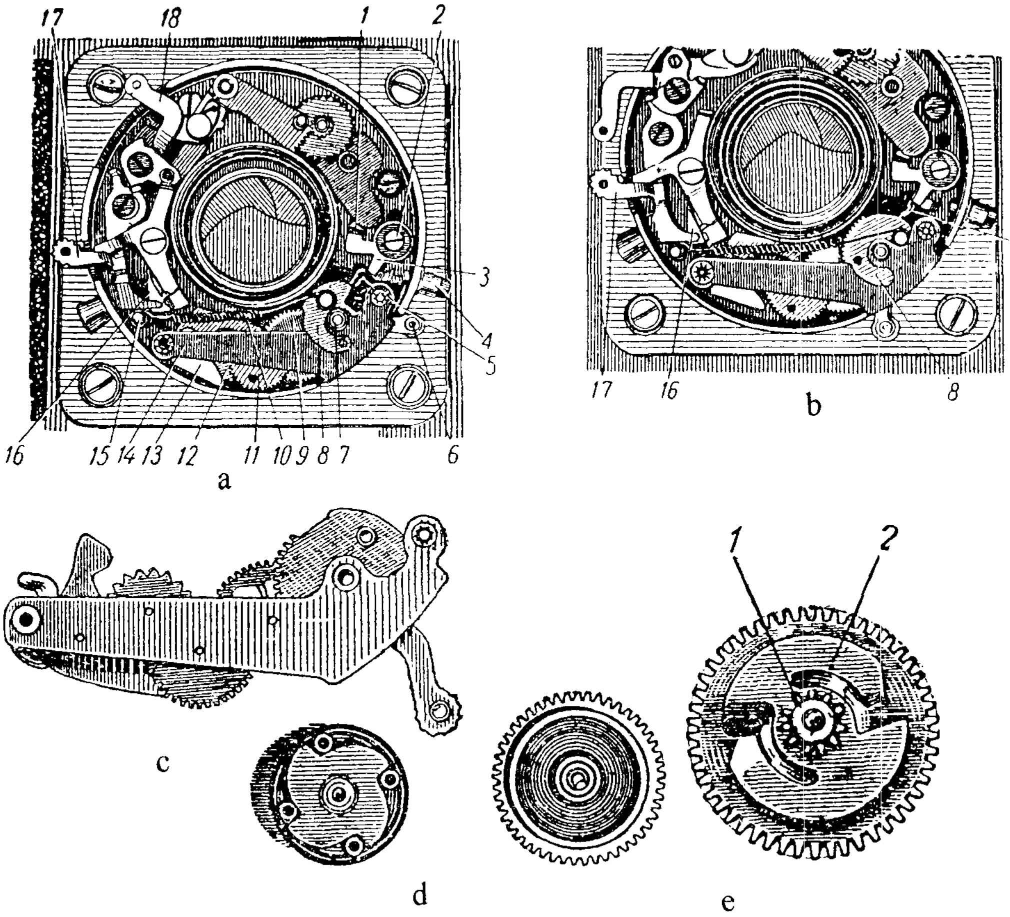


Figure 80. The shutter mechanism:
a - positions of the parts before winding; b - positions of the parts after winding; c - the selftimer mechanism; d -the clutch device of the selftimer mechanism; e - the new design of the clutch device.

the shutter base shaft. It makes the pallet, along with the delay mechanism, immovable. The delay mechanism in the wound spring position is called the reset position.

Before winding the selftimer mechanism, wind the shutter mechanism - lever *18*.

Note the shape of the segment *8*. Part of the segment positioned opposite the stamped out tip *5* is cut out. The tip *5* is on the ring-link *8* (Fig.75), and moves along with it at the release of the shutter. During operation without the selftimer, when its mechanism is not wound (see Fig.80a), the ring-link moves freely because the tip *5* enters the cut in the segment *8*. But when the selftimer mechanism is wound (see position on Fig.80b), the tip *5* leans on the segment *8* curve and prevents the ring-link from turning. Therefore, the shutter cannot trip.

When the release lever *17* (Fig.80b) is pushed and the shutter is released, the lever bending presses the hook *16*, and it releases the delay mechanism, activating it for 8-10 sec.

Simultaneously, the segment *8* holding the tip *5* on the ring-link turns slowly. When the segment *8* turns enough for the tip *5* to coincide with the cut in the segment, the shutter trips.

Mechanism disassembly. To take the delay mechanism out of the shutter, remove the loop of the spring *10* (Fig.80a) off the pin *15*; then push the shutter release lever with your left hand and remove the mechanism by turning it on the shaft *7* in both directions with your right hand.

The selftimer mechanism is disassembled as follows. Unscrew the two screws holding the plates together, remove one of them, and take out all the gears and the pallet. Disassemble the mechanism only if absolutely necessary. Before disassembling, study and memorize the positions of the parts.

Selftimer malfunctions. 1. ***After the shutter release lever is depressed, the selftimer mechanism does not work, or stops arbitrarily during the operation.*** This is the most common selftimer malfunction caused by dirt and poor linkage between the mechanism gears.

The problem is fixed by cleaning and lubricating the mechanism. The mechanism is cleaned in benzine, and all the gear teeth are carefully checked. Cleaning and polishing of the gear and pallet shafts requires particular care. The sockets in the plates are cleaned with a sharp pointed wooden stick. After the cleaning, the shafts should be moderately lubricated with watch oil.

The selftimer mechanism could be malfunctioning for another reason. As a result of a bad flash plug, the interior insulated contact of the flash socket *4* (Fig.80a) sinks into the shutter and obstructs the rotation of the flash synchronization mechanism *3*; the ring-link cannot move either. Put the contact back, and to prevent it from sinking in, squeeze the exterior part of the flash socket with pliers.

2. ***After the selftimer mechanism is wound up, the winding lever arbitrarily returns to the starting position.*** This defect is caused by malfunctioning of the delay mechanism clutch device. When the selftimer is being wound, the segment gear *8* (Fig.80a) turns freely, and the mechanism gears do not move. During the mechanism operation, it turns in the opposite direction, and the gears start their rotation. When the segment gear *8* handle *6* is turned, the spring *10* winds up and the clutch device holds the selftimer mechanism in the reset position.

The clutch device is located inside the drum on the gear *9*. It consists of a wheel with cuts (Fig.80d) and of rollers mounted in them. If the rollers are dirty or have oil on them, they stop functioning, and after winding the mechanism the handle *6* and the segment *8* arbitrarily return to the starting position. To eliminate this malfunction, disassemble the mechanism and clean it in benzine; after the cleaning, oil the gear and pallet shafts only.

In some modifications of the "Smena" camera, the delay mechanism clutch device is designed slightly differently.

Instead of the drum with the wheel and rollers, a set of radial slots is made on the gear *9* (see Fig.80e). A spring with two bent ends is attached to the dial (it is located under the gear). When the mechanism winds, these bent ends turn counter-clockwise and freely slide along the gear surface. They cannot move freely in the opposite direction because they are caught by the gear radial slots and engage the delay mechanism. This clutch device is much more reliable.

3. ***During the selftimer mechanism operation, the shutter blades slightly open and let the light into the camera.*** This is caused by the deformed stamped out tip *5* (Fig.80b) which leans on the segment *8* during the selftimer mechanism operation, and holds the ring-link along with the shutter blades in the closed position.

Deformation of the stamped out tip can be lateral or longitudinal. If it is longitudinal (the tip is bent backward), the ring-link slightly shifts forward, and the blades slightly open. To fix this problem, straighten the tip *5* and set it strictly vertically.

Lateral deformation causes the malfunction described below (in problem No. 4).

4. ***The shutter blades cannot turn freely.*** This problem can be caused by two factors: the tip *5* is slightly bent to the side, and during the shutter operation, it rubs against the delay mechanism; the blades move inertly or do not close at all. The deformed flash synchronization contact *3* hooks the ring-link with its bending and obstructs its movement. In both cases it is necessary to eliminate deformation of the indicated parts.

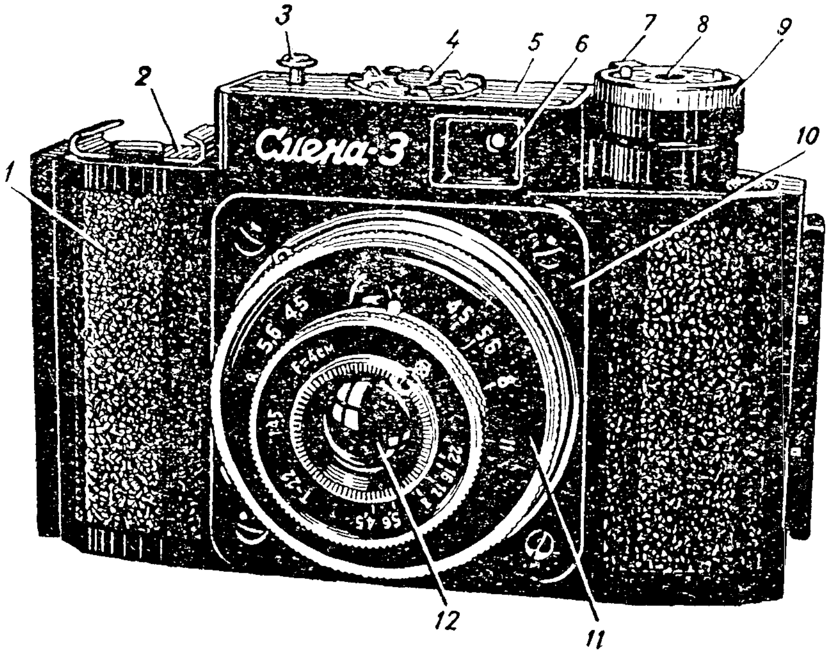


Figure 81. The "Smena-3" camera.

Flash Synchronization Mechanism

The flash socket *4* (Fig.80) is located on the shutter body. The contact mechanism inside it consists of the figured contact *3* installed on the shaft and fastened with the screw *2*. There is a spring underneath the contact. Its one end is pressed against the shutter's body, and its other end is pressed against the arm of the contact. The screw *1* is on the ring-link.

The flash synchronization mechanism operational principle is the following. During the shutter operation the ring-link turns the blades, and with the help of its screw *1*, it turns the contact *3*. The arm of the contact touches the interior insulated contact of the flash socket *4* and closes the electric circuit.

When the ring-link returns to its starting position, the contact is turned by the spiral spring, thus breaking the electric circuit. During subsequent winding of the shutter, the ring-link does not move, and, therefore, the electric circuit does not close at the winding. A pulsed flash works with every shutter speed.

The contact *3* and the spiral spring returning the contact to the starting position are the most likely causes of the flash synchronization mechanism malfunctions. The exact cause of the malfunction can be detected very easily by observing the operation of the partially disassembled shutter and by reviewing the condition of the flash socket *4*. The flash socket should not be loose, and the interior contact has to be insulated from the body.

"SMENA-3"

The "Smena-3" camera (Fig.81) differs from "Smena" in that it has an improved film wind mechanism and shutter release system. The film winding knob is replaced with a lever which allows to reload the camera quickly. Other camera units are modified somewhat as well.

Major Camera Assemblies and Parts

The camera consists of the body *1* (Fig.81), accessory shoe *2*, release button *3*, exposure counter *4*, top plate *5*, viewfinder *6*, film winding lever *7*, reminder scale *8*, fastening rim *9*, lens panel *10*, shutter *11*, and lens *12*.

Lever Film Winding Mechanism

The lever *6* (Fig.82) is installed on the film winding mechanism base *2* (Fig.83). Turning clockwise, the lever makes a working cycle; turning in the opposite direction, it makes an idle motion. This is achieved by the ratchet-wheel *1* (Fig.82) sitting on the shaft *4* of the rewinding fork and by the pawl *2* which is driven by the spring *3*. When the lever *6* is turned, the pawl *2* attached to the lever gets into one of the notches on the ratchet-wheel *1* and puts to work the shaft and the rewinding fork. After the winding, the lever is returned to its starting position by the band spring located under the lever. The shaft and the winding fork do not move due to the brake spring *1* (see Fig.66).

Mechanism disassembly and reassembly. Unscrew clockwise the fastening rim *9* (Fig.81) with the left hand thread. You will find a black washer and a screw under it (not shown in the figure). After unscrewing the screw and removing the washer, the ratchet-wheel *1* (Fig.82) and the pawl *2* can be removed, and then the lever *6* can be taken out. Underneath the lever, there is the band spring and its shield (Fig.83). The lever should be removed and reinstalled together with the shield. The spring is always wound; and if the lever is removed by itself, the spring may get loose and fall out. To reinstall the spring, pick up the shield *1* with your left hand, holding it by the pin, and with your right hand hook the spring's end (there is a cut 12-15 mm away from the end for this purpose) and insert it in the shield while turning clockwise. Then place the shield with the spring into the groove under the lever where the pin is located. This pin has to enter the curved end of the spring. To reinstall the lever and the shield in the body, turn the lever clockwise by the shield pin, winding up the spring, and place it onto the body as shown in Figure 83. At this point, the shield pin has to enter the hole in the body (see arrow).

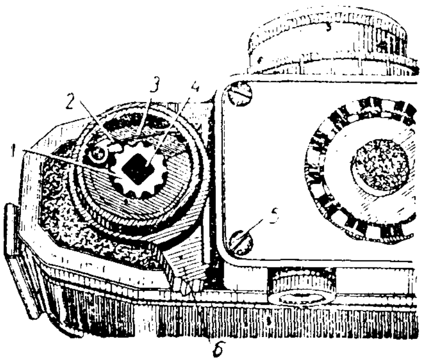


Figure 82. The winding mechanism.

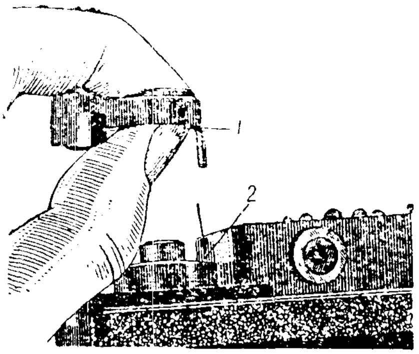


Figure 83. Installation of the winding lever.

Mechanism malfunctions. In addition to the malfunctions described in the chapter on the "Smena" camera, following malfunctions are possible:

1. ***The lever 6 (Fig.82) does not return to its starting position after winding.*** Check the condition of the band spring underneath the lever: the hooks on its ends should be intact; the screw under the scale *8* (Fig.81) has to be tightened up. If the screw is loose, the lever becomes elevated, and its pin is dislodged from the hole in the spring. Spring installation was described above.

2. ***When the lever 6 (Fig.82) is turned, the winding fork does not move.*** Check the pawl *2* and its spring *3*. If the spring is weak, it needs to be strengthened by bending; if the spring is broken, it has to be replaced with a new one. A used clock spring can serve for this purpose. If the pawl *2* tooth is worn out, it can be fixed with a file. The pawl shaft has to be lubricated.

This problem may also arise if the end of the shaft *4* is broken off as a result of using bad cartridges. The wearing out and breaking of the pawl *2* is caused by the same reason.

After winding, the lever *6* should be returned to its starting position gently, without hitting the camera body; otherwise it can cause damage.

Interlocking and Release Mechanism

By pushing the button *3* (Fig.81), the shutter is released and, simultaneously, opens the interlocking for film advance to the next frame. The interlocking (release) mechanism has the same design as the one in the "Smena" camera, while the exposure counter is slightly different. In the "Smena-3" camera, the protective glass is not fastened to the top plate with a spring, but is held by a spiral spring *2* (Fig.84) to the plate *5* (Fig.81).

The release mechanism's operational principle is as follows. The lever *3* is installed on the release button's *3* rod. When released, this lever pushes the rod *3* (Fig.84) into the body cavity. The rod shifts the release lever *5* (Fig.85) which pushes the pin of the shutter release lever. The release lever *5* is fastened with two ledged screws *6* and *9*, guiding it, the spring *7* returns the lever to the starting position. The pin *8* (Fig.85) on the release lever *1* (Fig.75) enters the hole in the shutter and is shifted by the release lever *5*.

The interlocking mechanism is identical to the one in the "Smena" camera.

Release system malfunction. ***When the button 3 (Fig.81) is pushed, the shutter release does not occur.*** Check whether the shutter and release mechanism are operable. Before shutter disassemby remove the lens panel *3* (Fig.85) with the shutter and examine the release lever *5*. If its fastening screws *6* and *9* and the spring *7* are in place, wind the shutter and shift it all the way down by pressing the lever *5*. The shutter should trip. If it does, the malfunctioning has occurred in the release system; if it does not, the shutter has a problem. After repairing the shutter, as

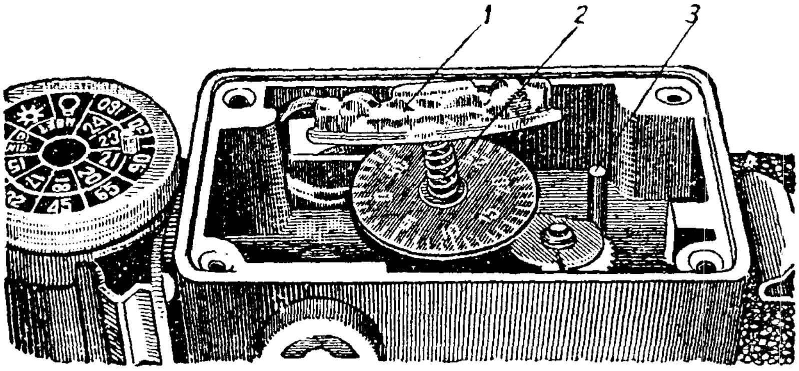


Figure 84. The exposure counter.

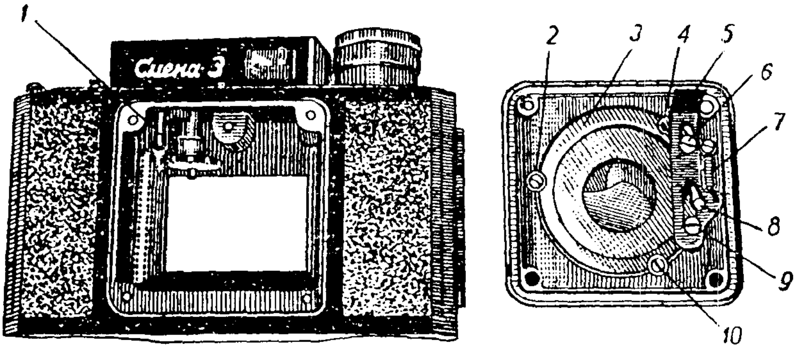


Figure 85. The shutter release mechanism parts.

described in detail in the chapter on the "Smena" camera, examine the release lever *5* and the pin on it (see "Shutter" below). If the shutter is malfunctioning, further camera disassembly is not required; only the shutter is disassembled. If the shutter is working properly, bend the foot of the release lever *5* a little upward, and that will increase its travel distance at the release.

Shutter

The shutter has the same design as the one in the "Smena" camera. The release lever and the disassembly sequence are slightly different.

For complete shutter disassembly, unscrew three screws *2*, *4*, and *10* (Fig.85) located on the back of the lens panel. These screws are holding not just the exterior shutter body, but also its interior base bearing the blades. The base and the shutter body have holes for the release lever pin

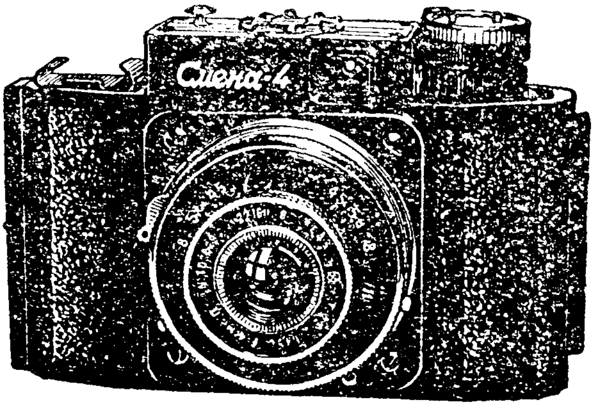


Figure 86. The"Smena-4" camera.

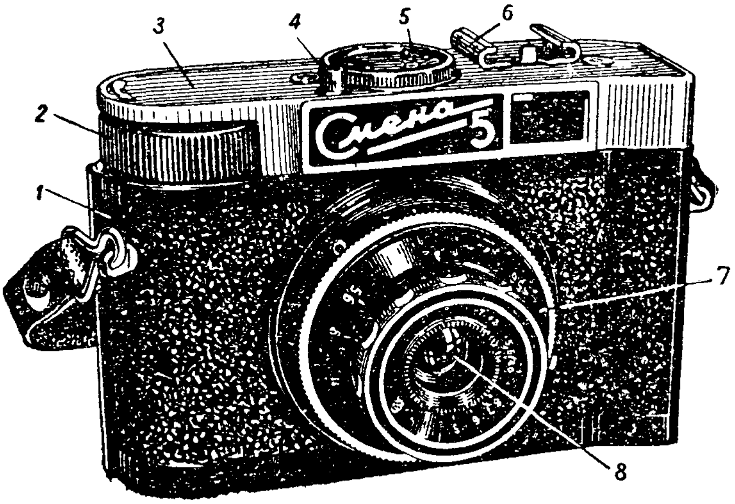


Figure 87. The "Smena-5" camera.

8. During reassembly, remember to put the black light-tightening washer on the pin *8* in the reverse side of the lens panel *3* underneath the release lever *5*.

In the "Smena-3" camera, the lever does not have a handle, but has a pin instead, which was mentioned above. If this pin is loose and there is a backlash, it can cause the malfunction described above. To secure the pin, remove the lens, the front protective shield, the shutter speed ring, and the release lever. Place the pin on a hard surface and rivet the joint.

"SMENA-4"

The "Smena-4" camera (Fig.86) is an improved modification of the "Smena-3" camera. It is equipped with a built in shutter selftimer mechanism and a flash synchronization mechanism for a flash. Its design, possible malfunctions, and repair are the same as in the "Smena-2" camera (see p.83).

"SMENA-5"

The "Smena-5" camera (Fig.87) has all the parts and units of the earlier modifications; therefore, we will only review the differences and the camera disassembly order. The winding knob and brake spring, the exposure counter, the lens and its adjustment are designed and repaired as described for similar units of the "Smena" camera. The viewfinder consists of one rectangular lens element located under the shield *3*. There is a spring plate under the viewfinder's lens element. To remove the shield *3*, unscrew the two top screws.

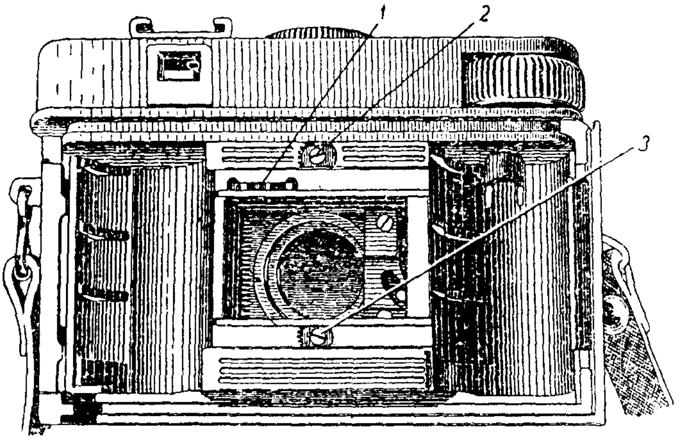


Figure 88. The film track.

Major Camera Assemblies and Parts

The camera consists of the body *1* (Fig.87), winding knob *2*, top plate *3*, release button *4*, film type reminder scale *5*, accessory shoe *6*, shutter *7*, and lens *8*.

Film Track and Film Advance Control Mechanism

All previous modifications of the "Smena" camera had the film winding from right to left;

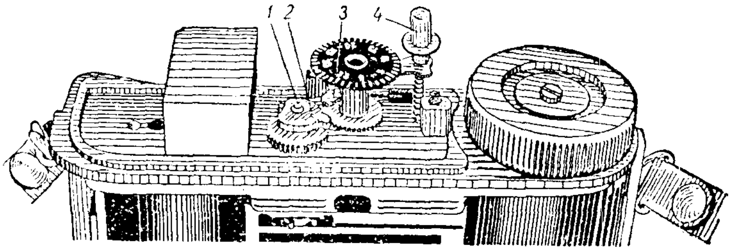


Figure 89. Positions of the parts under the top plate.

in "Smena-5" the film is wound from left to right. The winding knob *2* (Fig.87) is sitting on the fork shaft and fastened with a screw. There is a brake spring underneath the knob.

When the film is advanced, its perforation rotates the sprocket *1* (Fig.88) screwed (by means of right hand thread) on the shaft *1* (Fig.89), and this involves the mechanism controlling the film's advance by one frame only. This mechanism has design and operation which are similar to those of the "Smena" camera. The difference is that instead of the pin *7* (Fig.70) the "Smena-5" has the lever *3* (Fig.89). When the pin *2* reaches the lever *3* and the shaft *1* cannot rotate anymore, the film stops. At the push of the release button *4*, the lever *3* goes down and gives way to the film.

Mechanism malfunctions and their elimination are described in detail in the chapter on "Smena".

Shutter Release Mechanism

The shutter release mechanism is identical to the release mechanism of the "Smena-3" camera. When the release button *4* (Fig.89) is pushed, the rod which bears it lowers and depresses the bending in the plate *4* (Fig.90). The plate turns the pin *5* on the shutter release lever.

The malfunctions of the shutter release mechanism are described in detail on p.88.

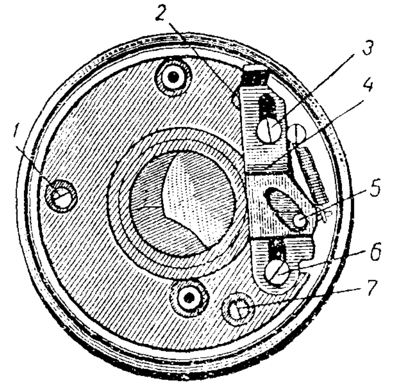


Figure 90. The reverse side of the shutter panel.

Shutter

The "Smena-5" camera shutter has the same design as the "Smena" shutter. The front part of the shutter is disassembled in same sequence as described for previous modifications. The back part (Fig.90) is disassembled as follows. Unscrew the screws *2* and *3* (Fig.88) and remove the front panel with the shutter. To separate the shutter, unscrew the screws *3* and *6* (Fig.90) and remove the release plate *4*. Then unscrew the screws

1, *2*, *7* and remove the shutter. The shutter is attached to the body with the same screws.

When reassembling, first join together the shutter base, the body and the front panel, and fasten them with the screws. After that, reassemble the front.

"SMENA-6"

The "Smena-6" camera (Fig.91) is an improved modification of the "Smena-5" camera with a selftimer built in the shutter mechanism. The selftimer design is identical to that in the "Smena-2" camera.

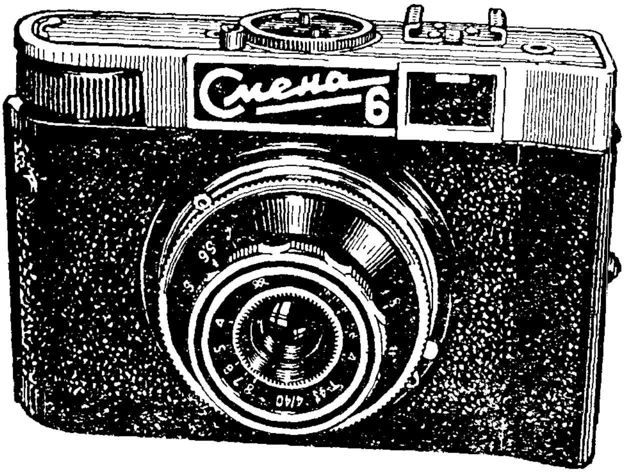


Figure 91. The "Smena-6" camera.

"SMENA-M"

The "Smena-M" camera (Fig.92) is identical to the "Smena" camera where the shutter release and interlocking mechanism release are joined in one unit. The mechanism controlling the

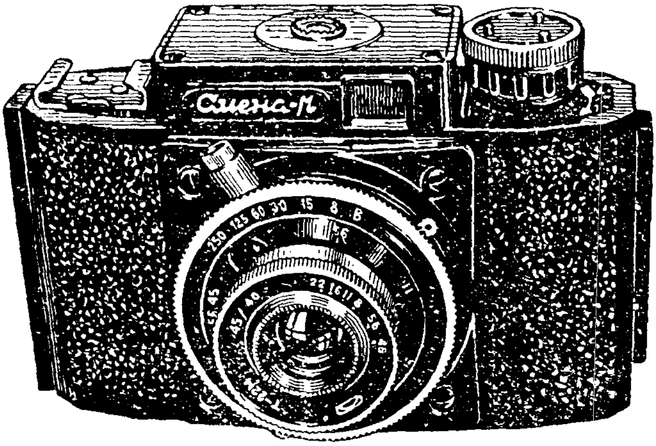


Figure 92. The "Smena-M" camera.

film advance by one frame is in principle no different than the mechanism in the "Smena-3" camera. The exposure counter design is slightly altered.

Camera Disassembly

The camera is disassembled in the same sequence as the "Smena" camera. Nonetheless, bear in mind that the spiral springs on the lever *1* shaft (Fig.93) and on the rod *2* shaft (Fig.94) may fall out when the front panel is removed. Therefore, it is necessary to hold the lever during panel removal.

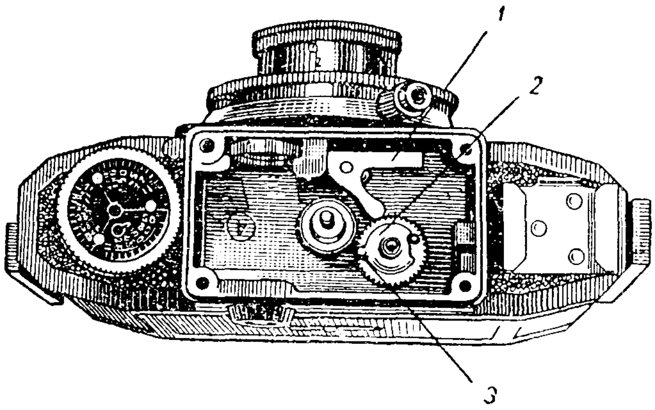


Figure 93. The release mechanism parts.

The rod *2* enters the hole in the lever *1* shaft (Fig.93). To remove the panel holding the shutter, unscrew the four screws on the front side.

The "Smena-M" camera exposure counter has the same design as the similar unit in the "Smena-3" camera (Fig.84). When disassembling and reassembling the camera, remember that the protective wheel *1* is driven by the spring *2*.

To remove the shutter, unscrew the screws *1*, *3*, *4* (Fig.94).

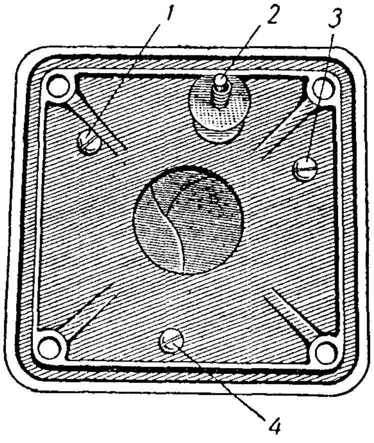


Figure 94. The reverse side of the lens panel.

Mechanism Controlling Film Advance by One Frame

The mechanism controlling the film advance by one frame is similar in design and operation to the one in all the other modifications of the "Smena" camera. But the shape and position of the lever *1* (Fig.93) were changed. The lever *1* stops the wheel *2* when the pin *3* reaches the lever *1*. During the shutter's release, the rod *2* (Fig.94) goes down and allows the film to advance to the next frame.

"SMENA-2M"

The "Smena-2M" camera (Fig.95) is an improved modification of the "Smena-M" camera with an automatic shutter release. Its design and repair are described in detail on p.83.

"VESNA"

"Vesna" is one of the new modifications of the camera group being described. Major units of the "Vesna" camera are the same as in the "Smena" camera. Compared to other cameras of the "Smena" brand, the new camera has a number of advantages: the film winding mechanism is interlocked with the shutter, and the shutter cannot be released until the film is advanced to the next frame. Its small size and light weight virtually make it a pocket camera. One film load yields 41 exposures with a 24 mm x 32 mm frame size.

The lens, the shutter mechanism, and the flash synchronization mechanism are identical to those in the "Smena" and "Smena-2" cameras.

Major Camera Assemblies and Parts

The "Vesna" camera consists of the removable cover *1* (Fig.96), winding wheel *2*, top cover *3*, wheel with index *4*, release button *5*, accessory shoe *6*, film type reminder scale *7*, body *8*, lens panel *9*, shutter *10*, and lens *11*.

Camera Disassembly and Reassembly

When disassembling the camera for repair, remove the top plate *3* (Fig.96) or the shutter. To remove the plate, unscrew the screw *1* (Fig.97) and the screw inside the camera (it is not shown in the Figure). To do that, insert a screwdriver in the hole on the spring lath *2* (see arrow). While unscrewing the screws, hold the plate in the left hand to prevent it and parts underneath it from falling out.

There is a spiral spring *7* (Fig.99) on the counter wheel shaft under the wheel *4* (Fig.96); a washer is located under this spring. The release button *5* is sitting on the release shaft. The spring *2* is not fastened. Therefore, when removing the plate, make sure that the above mentioned parts do not fall out.

To remove the shutter, unscrew the three screws inside the body. Two out of the three screws (*1* and *4*) are shown in the Figure 98, and the third is located in the same place. Now, turn the shutter 90° and remove it. The shutter is turned to get the screw *8* (Fig.100) out of the rectangular groove in the front camera panel. The front panel is fastened with the flat-headed screws *1*, *2*, and *3*.

Film Track and Interlocking Mechanism

The film is advanced with the help of the winding wheel *2* (Fig.96) sitting on the fork *3* shaft (Fig.98). The brake spring on the fork shaft is positioned under the wheel. This spring allows the wheel to turn counter-clockwise only. The advancing film turns the sprocket wheel *2* screwed on the shaft of the interlocking mechanism (right hand thread). The sprocket wheel

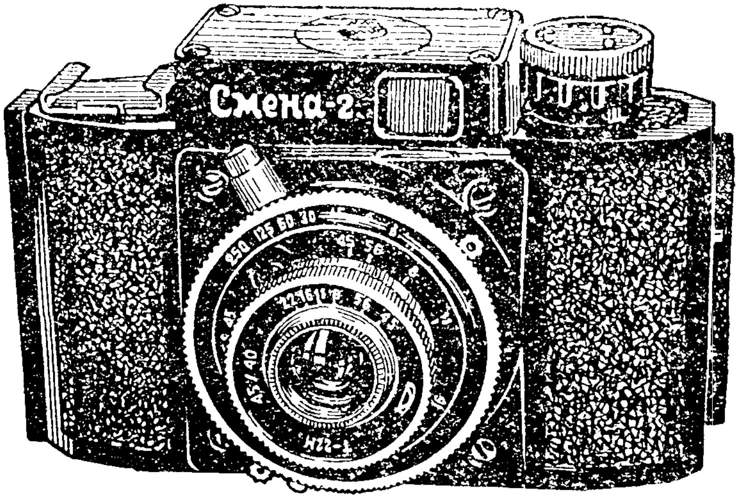


Figure 95. The Smena-2M" camera.

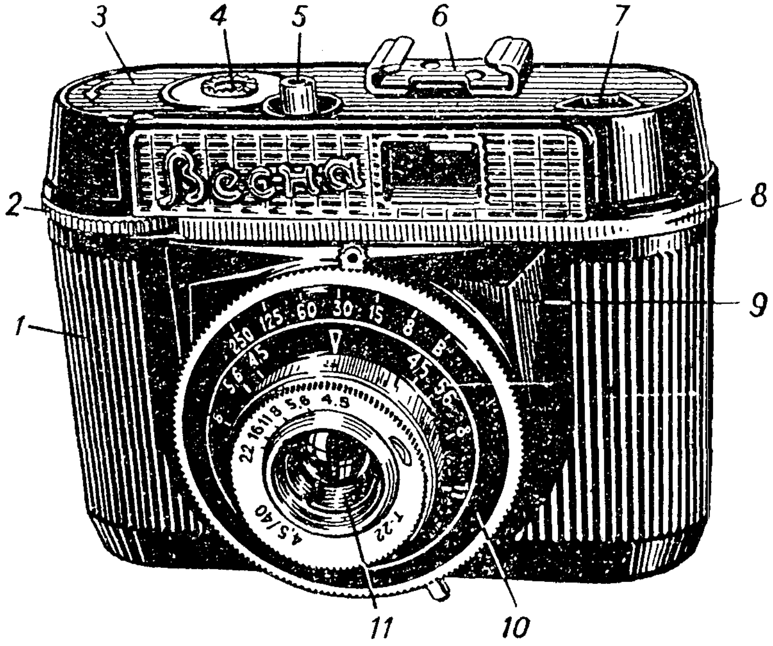


Figure 96. The "Vesna" camera.

rotates the shaft bearing the wheel *3* (Fig.99) with the pin *6*. When the pin *6* reaches the pin *4*, the film stops. Note the two cuts on the wheel *3* next to the pin *6*. When the pin *6* reaches the pin *4*, the shutter can be released because the second pin is positioned under the cut in the wheel

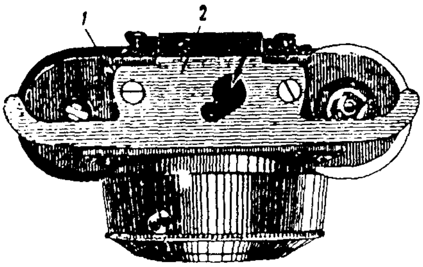


Figure 97. The camera body.

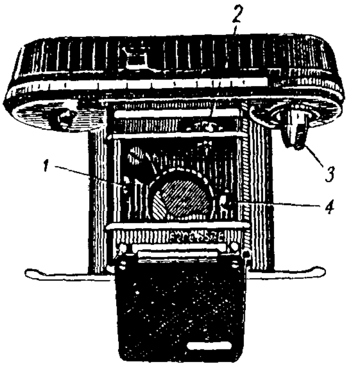


Figure 98. The film track.

(released interlock) and allows the release button *5* to lower. In any other position of wheel *3*, the knob *5* cannot lower because the end of the pin *4* rests against the wheel.

There is a spring under the wheel *3*, and the wheel has some free wheeling relative to the gear located above it. When the film is advanced and the pin *6* reaches the pin *4*, the film does not stop instantly, but keeps moving as long as the gear under the wheel *3* is able to turn (about 50°). At this time the spring under the wheel is wound. After the release button is pushed, the wheel *3* turns 50°, driven by the spring, and the pin *4* once more finds itself on the other side of the pin *6* above the wheel. Now it becomes possible to wind the shutter again.

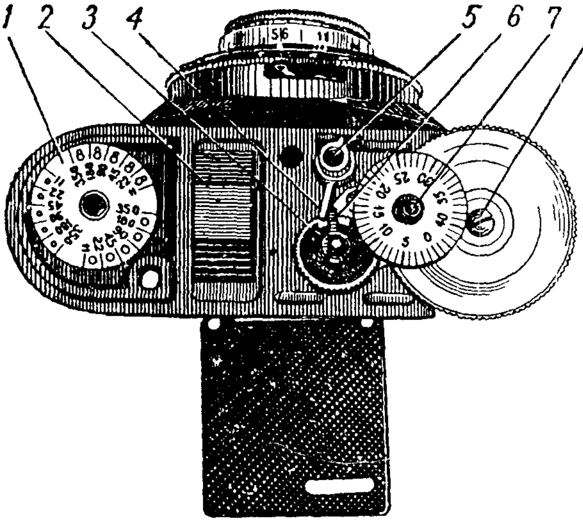


Figure 99. The release interlocking mechanism.

Mechanism malfunctions. 1. ***The rewinding wheel 2 (Fig.96) does not rotate the rewinding fork 3 (Fig.98).*** As the photographer, you will become aware that the rewinding wheel has some backlash. This problem arises when the screw *8* (Fig.99) is loose. To fix it, remove the top plate *3* (Fig.96), put the rewinding wheel back in its place, and tighten the screw.

2. ***The film winds endlessly, and the interlocking mechanism is not functioning.*** This problem emerges when the pin *6* (Fig.99) is broken. In the early models of the camera, the wheel *3* and the pin *6* were made of plastic; in later models they were metal. The pin *6* brakes off only when significant force is applied while winding the film. Thus the cartridges should be good, and the film has to advance without significant force. To eliminate this malfunction, make a new metal wheel with a pin. The wheel is fastened with a cut washer.

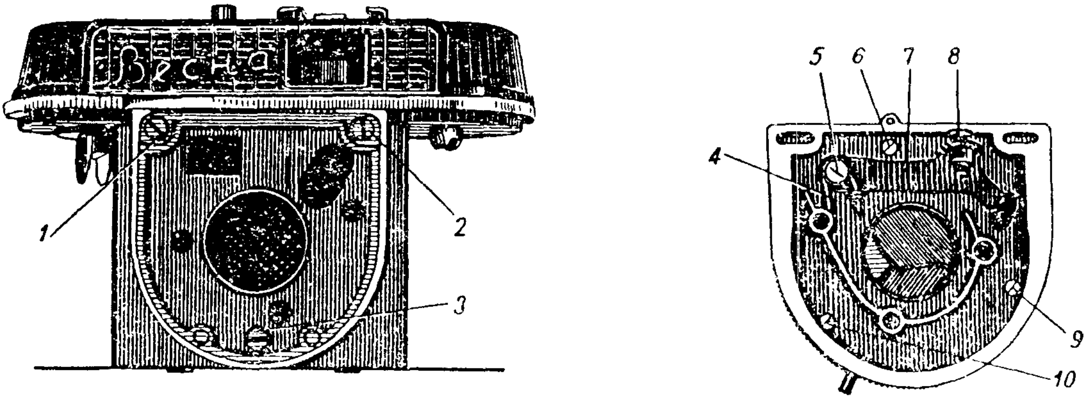


Figure 100. The front panel and the back of the shutter.

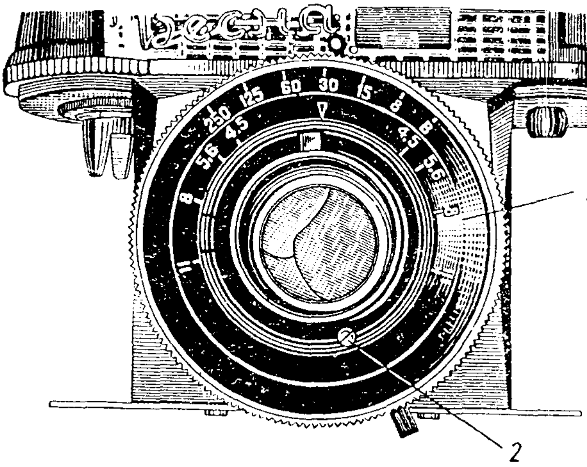


Figure 101. The front side of the shutter.

3. ***When the release button is pushed, the shutter does not trip.*** First of all check whether the shutter is functioning. To do that, unscrew the screws and remove the shutter. Then wind up the shutter and release it by pushing the lever *7* (Fig.100). If the shutter is in order, adjust

the height of the screw *8*. The bottom of the screw has a slot. Insert a screwdriver in it, and by turning the screw raise its head somewhat. The shaft of the release button *5* (Fig.99) rests on the head of this screw. Its elevation increases the turning angle of the lever *7* (Fig.100). This lever turns on the shaft *5* and is returned to the starting position with the help of the spring *4*.

Shutter

The shutter mechanism is similar to the shutter mechanism in the "Smena" camera (see p. 77). The disassembly order of its front part is slightly different. To remove the lens, unscrew the set screws, remove the front rim, mark the thread entry (see p.77), and remove the lens. Then unscrew the screw *2* (Fig.101), turn the scale *1* wheel counter-clockwise 10-15^{o} until the two guides on the wheel coincide with grooves in the shutter base, and remove the wheel. To take out the shutter base, unscrew the screws *6*, *9*, and *10* (Fig.100).

"KIEV-VEGA" CAMERA

The "Kiev-Vega" camera (Fig.102) is a miniature camera with 10x14 mm frame size. One film load yields 20 exposures. Its light weight and small size make it a pocket-size camera. The camera has simple design and is easy to operate. The shutter and the rewinding mechanism are interlocked. The flash synchronization mechanism allows flash at any shutter speed.

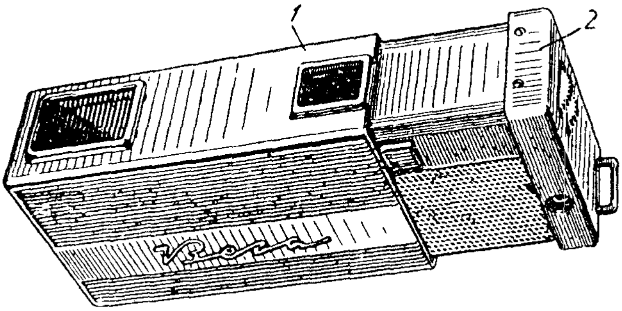


Figure 102. The "Kiev-Vega" camera.

Design and Operational Principle of Camera Mechanisms

All the mechanisms of the "Kiev-Vega" camera are driven with one shift of the mounting plate *1* (Fig.103). The mounting plate's movement is limited by the lath *5* placed in the groove *2*. The pin *3* in the groove *4* slides along the elliptic groove. The pin *3* is attached to the back of the wheel *3* (see Fig.108); its location is marked with an arrow. The wheel *3* is connected with the fork *1* pulling the film (see detailed description below). When the mounting plate is shifted to the right, it rotates the fork. When it shifts back, the fork does not move. Simultaneously when the mounting plate is extended, the pin *3* (Fig.103) gets into one of the grooves in the exposure counter wheel *6* and turns it one point forward. The bending *8* located in the hole *9* is connected with the plate *6* (see Fig.108) holding the film in the film track. Figure 110 shows the connecting plate *2* with the pressure plate *6* (Fig.108). The plate *2* bending (Fig.110) is inside the hole in the camera's interior body. This bending is marked *8* on Figure 103. Thus when the mounting plate *1* is extended, the bending *8* (Fig.103) reaches the edge of the hole *9* and presses the film in the film track. When the fork *1* (Fig.108) pulls the film, the bending *8* (Fig.103) releases the pressing plate and allows the film to advance freely. In addition, the mounting plate's movement winds the shutter (the shutter operation is described in detail below).

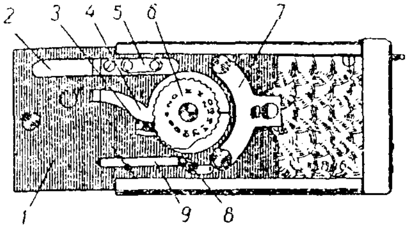


Figure 103. The camera mounting plate.

Camera Disassembly and Reassembly

First of all, remove the wrist strap and the casing *1* (Fig.102). Then unscrew four screws and remove the side shield *2*. Take the mechanism out of the exterior body (see Fig.104) and remove the mounting plate *1* (Fig.103). At this point, memorize the position of the lath *2* (Fig.106) and remove it. Figure 107 shows the mechanism without the mounting plate. Note the side shields *4* and *9*. Figure 107 shows shield bendings only, and Figure 104 shows one of the shields as marked *2*. Figure 107 shows the hole *10* where the pin *11* is located and moves. Part of the bending on the shield *9* is cut out; memorize the position of this cut-out part for correct shield reinstallment camera reassembly.

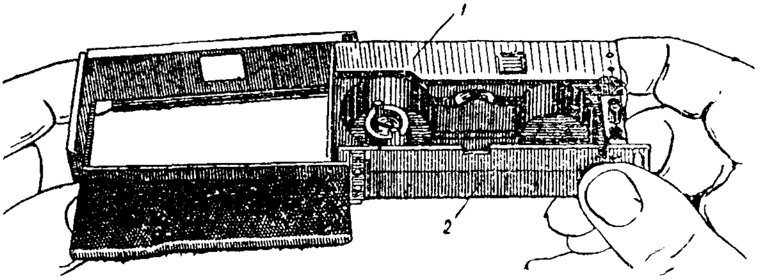


Figure 104. Installing the mechanism in the exterior body.

Figure 107 shows the hole *3* where the pin *3* (Fig.103) is located and moves. The rewinding fork base *1* (Fig.108) is fastened with the screw *2* (Fig.107). Do not unscrew the screw *2* (Fig.107) during camera disassembly. Unscrew the screws *1*, *5*, *7*, and *8* (Fig.107) and take the mechanism out of the interior body (see Fig.110). Figure 109 shows how to properly hold the mechanism parts while putting it back in the body.

It should be handled similarly during its removal from the body. Remember that the mechanism should be taken out and put back in from the top and not from the side.

The mechanism consists of two separate and independent parts: the plastic film track (its front view is shown on Fig.114) with the lens and diaphragm and the focal plane shutter (Fig.111).

The reassembly order is reversed. It is important that the mechanism be installed correctly in the exterior and interior bodies. To install the mechanism in the interior body, pick up the parts as shown on Figure 109 and slide them into the body. The plate of the focal plane shutter should be positioned behind the stamped tips *1* and *4* (Fig.110) controlling the position and immobility of the plate. The bendings *5* (Fig.114) and *9* (Fig.111), which form the electric circuit of the flash synchronization mechanism, should meet. After that you may screw in the screws *1*, *5*, *7*, and *8* (Fig.107).

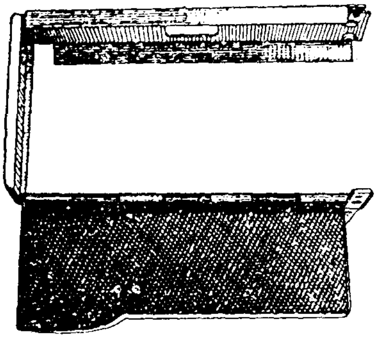


Figure 105. The camera exterior body.

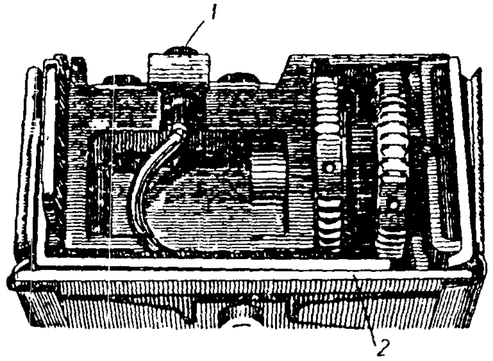


Figure 106. The side view without the shield.

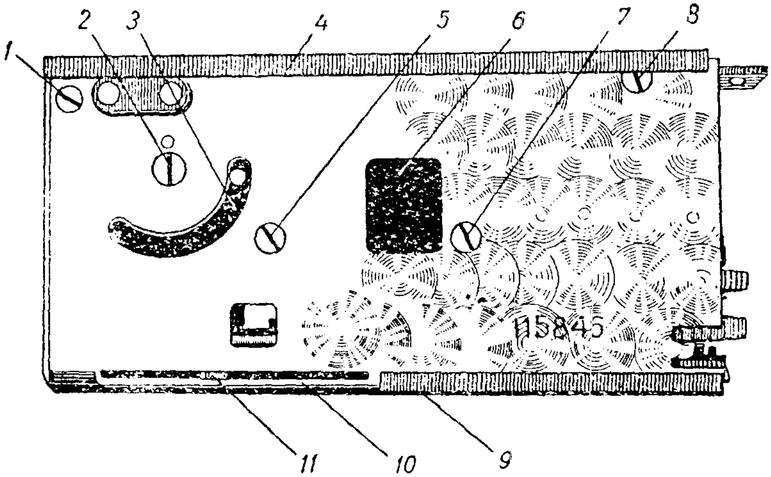


Figure 107. The mechanism (the mounting plate is removed).

Before reinstalling the mechanism, check to see whether the shim *3* (Fig.110) and the plate *2* are in place.

To reinstall the mechanism in the exterior body, put back the lath *1* (Fig.104), reinstall the shields *4* and *9* (Fig.107), and while holding the mechanism in your right hand, slide the mounting plate and the shields inside the body as shown on Figure 104. Then install the lath *2* (Fig.106) and put on the shield *2* (Fig.102).

Film Transport Mechanism

The film is transported from one cartridge compartment to the other by the fork *1* (Fig.108). The fork is fitted on the wheel *3* shaft and fastened with a screw *2*. There is a spiral spring under the fork. It allows the fork to turn in one direction, while braking the rotation in the other direction.

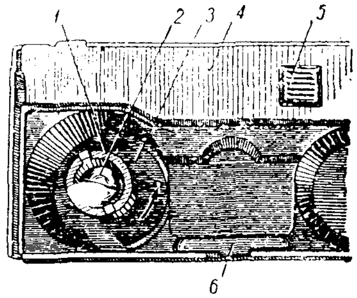


Figure 108. The rewinding fork and release button.

Malfunction of the film transport mechanism is uncommon.

Make sure that the screw *2* is tightened up, the spring is in place, and the pin *3* (Fig.103) on the wheel *3* (Fig.108) is secured well and does not have a backlash.

To disassemble the film transport mechanism, it is enough to unscrew the screw *2* (Fig.108).

The film in the film track is pressed by the support plate *6*. Its design and operational principle were described in detail in the preceding section.

Focal Plane Shutter

The metal shutter with the fixed slit consists of two curtains driven by the spring *16* (Fig.111).

Shutter operational principle. There are two curtains in the grooves of the shutter base *5* (Fig.113a); they are positioned one over the other. The top curtain *2* is shown on Figure 113a, and the bottom one *6* is shown on Fig.113b. To simplify matters, let us call the curtain *2* the first curtain and the curtain *6* the second one. Figure 113a shows the curtains in the unwound position, and Figure 113b shows them in the wound position.

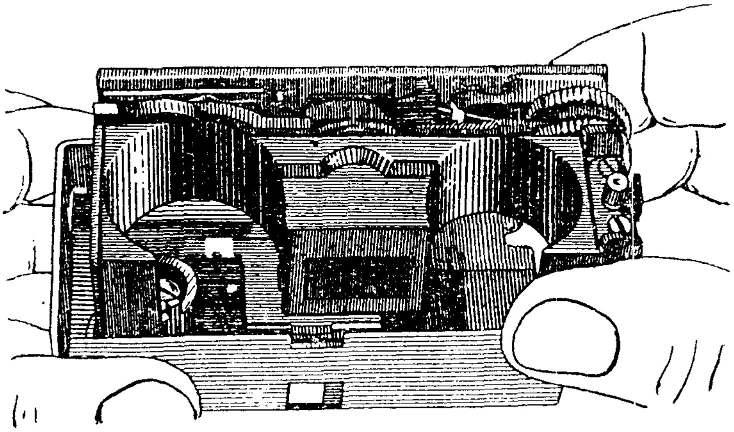


Figure 109. Installing the mechanism in the interior body.

When the shutter is unwound, the frame window *15* (Fig.111) is covered by the second curtain. The second curtain has the pin *1* and two bendings *7* and *14*. All three are located and move inside the holes in the shutter base *5* (Fig.113a). When the shutter is unwound, they are positioned all the way to the left. The first curtain has the bending *18* (Fig.111) and the tip *17*. The spring *16* is hooked to the bendings *14* and *18*.

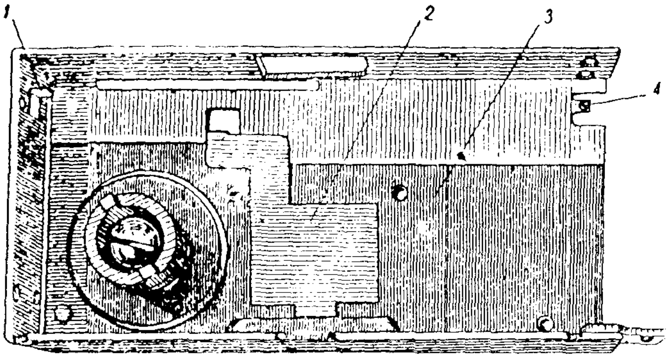


Figure 110. The interior body.

To wind the shutter and advance the film, close and open the camera. In the process, the mounting plate *1* (Fig.103) shifts the curtains and resets them (Fig.113b) with the tip *17* (Fig.111)

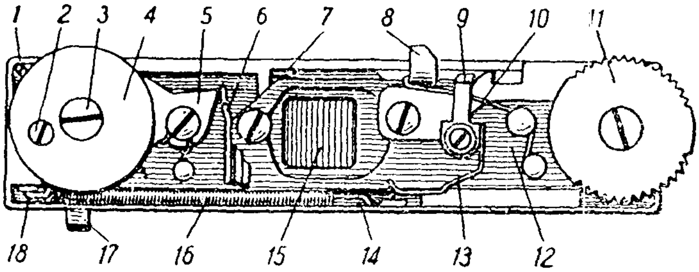


Figure 111. The unwound shutter mechanism.

inside the hole in the mounting plate (see arrow on Fig.103). The bending *7* (Fig.112) enters the groove in the release lath *8*, and the pin *1* goes all the way to the right. Then the first curtain

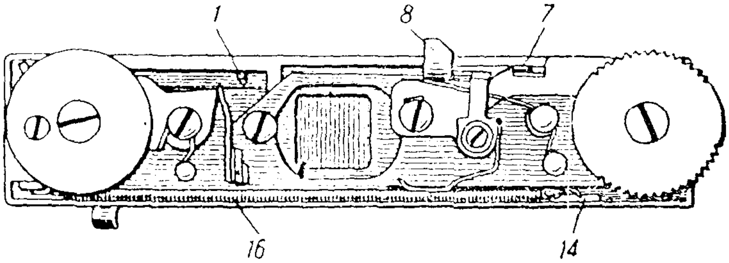


Figure 112. The wound shutter mechanism.

returns to the starting position (the mounting plate moves back and forth), but the second curtain cannot return because the lever *8* holds the bending *7*. At the same time the spring *16* (see Figures 111 and 112) is stretched.

When one pushes the release button *5* (Fig.108), the lever *8* (Fig.112) goes down and frees the tip *7*. This allows the second curtain driven by the spring 16 to return to the starting position.

When the shutter is wound, the frame window of the first curtain *2* (Fig.113b) is positioned opposite the frame window *15* (Fig.111). But the frame window of the first curtain is covered by the second curtain, so a red dot appears in the frame window field (see Fig.113b).

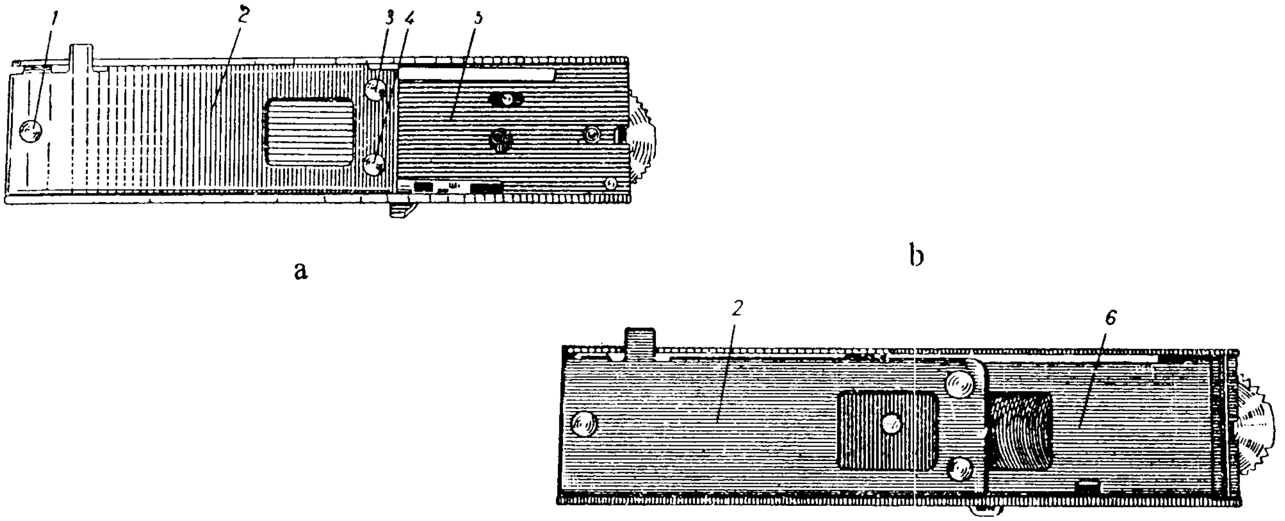


Figure 113. Shutter curtains:
a -in the unwound position; b - in the wound position;

When the shutter is released, i.e., the second curtain returns to the starting position, its frame window passes by the overlaid frame windows of the first curtain and the shutter base, opening the lens to the light.

Shutter speeds. The shutter speed (1/30; 1/60; 1/200 sec) depends on the speed of the second curtain which is controlled by the lever *5* (Fig.111) and the fly-wheel *4*.

When the second curtain is moving, the pin *1* which is affixed to it hits the lever *5*. The lever is connected to the fly-wheel *4* by means of the screw *2*. When the pin *1* slides along the curve of the lever *5*, the lever turns together with the fly-wheel. The lower the lever's position, the less time it takes to overcome this obstacle, and the higher the curtain's speed.

To set a certain speed, turn the wheel *11* that shifts the lath *12*. The lath *6* bending pushes the lever *5* and sets it in the necessary position. At 1/200 sec speed, the lever and the fly-wheel are switched off and do not slow down the curtain.

Shutter malfunctions. 1. ***Speeds 1/30 and 1/60 sec do not work.*** Check the mobility of the lever *5* and the fly-wheel *4* as well as the condition of the spring that is located on the lever *5* shaft and drives it to the starting position. Oil the lever shaft.

2. ***After the release button is pushed the shutter does not trip.*** Sometimes one of the curtains moves with great difficulty. Check whether the curtains are straight and file the surfaces *1*, *3*, and *4* (Fig.113a) a little.

3. ***The second curtain does not return to the wound position.*** Check the mobility of the lever *8* (Fig.111) and the condition of the spring driving it to the starting position.

Flash Synchronization Mechanism

The flash socket *1* (Fig.106) is an electric wire connection to the contact mechanism inside the body.

The contact mechanism consists of the contact with two spring bendings *9* and *13* (Fig.111). The wire *4* (Fig.114) is soldered to the contact *3*. When the camera is assembled, the bending *5* of this contact is connected to the bending *9* (Fig.111). This is how the electric circuit is formed: it closes when the curtain bending *14* touches the contact bending *13* during the second curtain's movement. The electric circuit closes at the moment when the shutter is completely open, so the pulsed flash can be used with any shutter speed. Note the bendings *13* and *14*. They have an elongated shape, and as the curtain moves, they slide relative to each other for a certain time, equal to the forestalling time necessary for disposable bulbs (see p.29). Therefore, in the "Kiev-Vega" camera disposable bulbs can be used with the 1/30 and 1/60 sec shutter speeds.

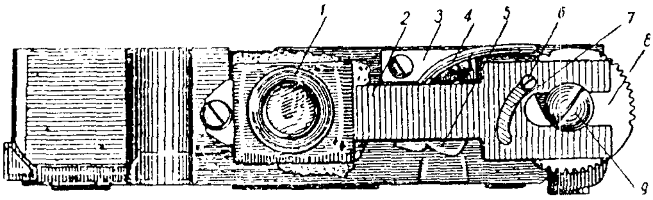


Figure 114. The lens and diaphragm.

If there is no contact in the electric circuit, check the reliability of the connection between the bendings *5* (Fig.114) and *9* (Fig.111), and also whether there is contact between the mobile bendings *14* (Fig.111) and *13*. If there is no contact, further incline the bending *13*.

Lens and Diaphragm

The "Industar-M" lens consists of three lens elements and is located behind the shutter. The lens has no focusing device and is fixed. The diaphragm is positioned between the second and the third lens elements.

The lens is disassembled as follows. Remove the rubber shim and unscrew the rim *1* (Fig.114) holding the front lens element. There is a loose shim between the first and the second lens elements. This shim comes out freely and allows the second lens element to be taken out. The third lens element is fastened with a ring to the back of the lens. The ring is screwed in on a thread. The diaphragm consists of two mobile plates with square holes. They are located in the lens mount slots. The plates are moved by the wheel *8* and the screw *6*.

Lens and diaphragm malfunctions are uncommon.

FED, "ZORKI", "ZORKI-2", "ZORKI-C", AND "ZORKI-2C" CAMERAS

This group of cameras is one of the most diverse with regard to variety and number of modifications. The entire group is based on the FED camera. Some of the FED camera assemblies were kept absolutely unchanged and used as a starting point not just for cameras in this group, but in other groups such as "Zorki-3", FED-2, "Zenit", etc. Besides, most repairs discussed in this chapter can be applied to other cameras described in the following chapters. This is why the FED and "Zorki" cameras received our particular attention.

FED AND "ZORKI" CAMERAS

The design of both FED and "Zorki" is absolutely the same, but they were manufactured at different plants. Later, both were used as a starting point for numerous modifications of design and equipment.

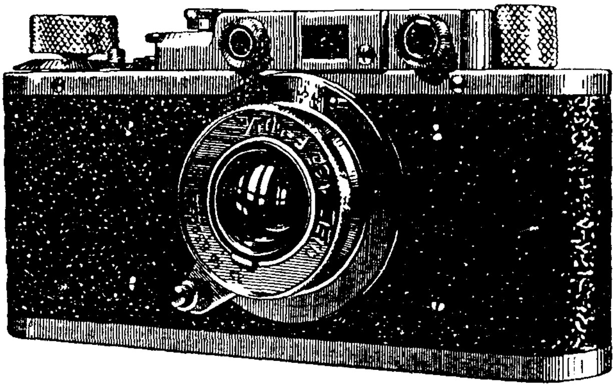


Figure 115. The FED camera.

Major Exterior Camera Assemblies and Parts

The exterior parts of the FED (Fig.115) and "Zorki" (Fig.116) cameras: the viewfinder eyepiece *1*, rangefinder eyepiece *2*, assembling plate *3*, film rewind knob *4*, rangefinder protective glass *5*, top plate *6*, accessory shoe *7*, shutter speed knob *8*, shutter release button rim *9*, switch lever *10*, shutter release button *11*, winding knob *12*, exposure counter dial *13*, and body *14*.

Removable Bottom Plate

The removable bottom plate (Fig.117) opens an access inside the body for loading the film. It is removed only for loading or getting out the exposed film. The tripod socket *2*, lath *3*, and lock 4 are located on the bottom plate. The tripod socket with 3/8" thread fastens the body on the tripod and centers the take-up spool shaft with a pin. The lath *3* gives rigidity to the camera body shell. The plate is fastened to the body with the ear *1* on one side and with the lock *4* on the other. The lock consists of a pointer with a cramp, lock lath, washer, and screw. The lock should turn with some force and, in its closed position, has to be under the cramp (old design) or in the slot in the shutter body (new design). In this position, the pointer arrow should indicate "Closed".

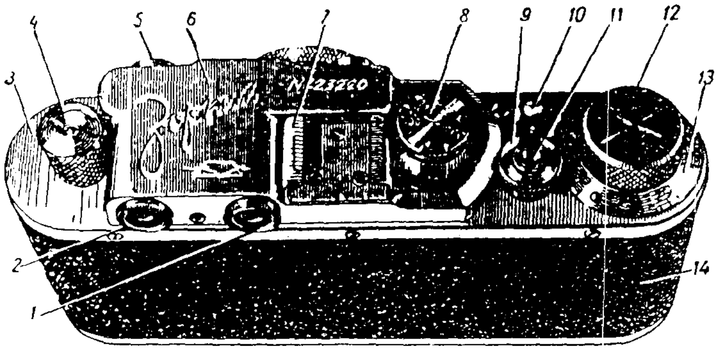


Figure 116. The "Zorki" camera.

If the plate is loosely fit onto the body, slightly bend the ear flange *1* inwards. If the lock closes freely and the plate has a vertical loose fit, bend the locking shoulder to create a slight tension. The stamped out tip of the lock holds the cartridge in the correct position in relation to the frame window. Its height is controlled by bending or filing.

The socket *2* is fastened with three screws that have to be tightened. If they are loose, the camera is not stable on the tripod.

Film Movement in Film Track. Film Rewind Mechanism, Support Plate, and Take-Up Spool

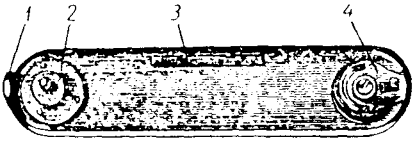


Figure 117. The removable bottom plate.

During camera operation, the film is transported from the cartridge through the film track and to the take-up spool. If the advance of the film is hampered, it can result in the overlapping of two shots, a broken perforation, etc. Normal advancing of the film depends on the correct operation of all three camera mechanisms: the film rewind mechanism (Fig. 118), the support plate *5* (Fig. 119), and the take-up spool *4*.

The film rewind mechanism consists of the knob *1* (Fig.118), ring *2*, screw *3*, bushing *4*, spring *5*, and fork *6*. The bushing *4* is fixed. The knob and the fork should turn freely and have a vertical gap taken up by the spring *5*. If the fork rotation is hindered, the film will advance with difficulty.

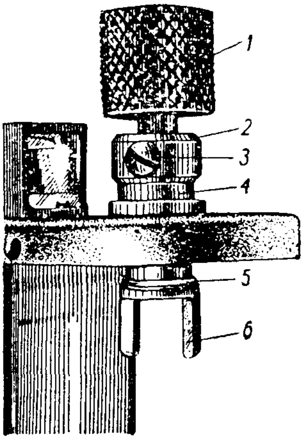


Figure 118. The film rewind mechanism.

The support plate *5* (Fig.119), along with the two springs underneath it, is positioned in a special milled hole in the camera body. It presses the film against the guiding runners of the shutter body. The lens is adjusted relative to these runners.

The support plate has to move freely or it will squeeze the film too hard and hamper its advance. To check whether the support plate has sufficient space for movement, wind the shutter, set the "B" speed (manually), push the release button, and hold the shutter open. Then with your left thumb press the support plate and check how freely it can move between the exterior body and the shutter body. The space of free movement should be no less than triple film thickness. The free movement of the support plate *5* should be checked when the camera is loaded because touching the uncovered support plate may result in its corrosion.

There should be no gap between the support plate and the exterior body wall because when loading the camera the film may get stuck between the support plate and the body. If the support plate does not have any space for movement, this may mean either that the body is deformed or the support plate is no longer in the milled hole. To fix this problem, you should take the mechanism out of the body (see p.109). Check the body thoroughly and straighten out the deformed surfaces. Put the support plate back and check the springs under it. The film is pulled by

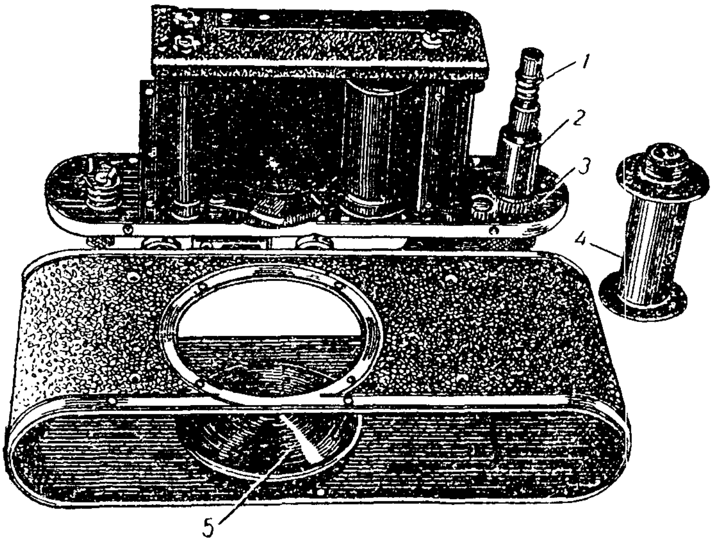


Figure 119. The parts of the film rewind mechanism.

the transport sprocket *2* (Fig.131) which is linked to the winding mechanism. The take-up spool *4* (Fig.119) reels up the film. The take-up spool should be fitted on the drum *2*.

Drum designs are different, but their operational principles are the same. FED of the old design has a large elongated drum fitted on the long shaft (Fig.119). The shaft of the tripod socket *2* (Fig.117) of the bottom plate enters the butt-end of the nut on shaft. In late models of FED and FED-2 the drum is short and sits on a short shaft while the tripod socket shaft enters the butt-end of the spool itself.

"Zorki" comes with a large drum. However, in early modifications the spool fits tightly on the drum, and in later models it fits loosely. The drum in these later modifications has special shoulders that are hooked by one of the two pins inside the spool.

The take-up spool drum is assembled with the winding gear *2* (Fig.125); the shaft of the drum is tightly screwed in the hole in this gear. The relatively strong spiral spring *1* holds the drum and is located between the drum and the support flange. Therefore, the drum turns when a certain momentum is applied. The drum with the spool can turn in both directions. It has special springs. Due to these springs, the take-up spool fits tightly on the drum.

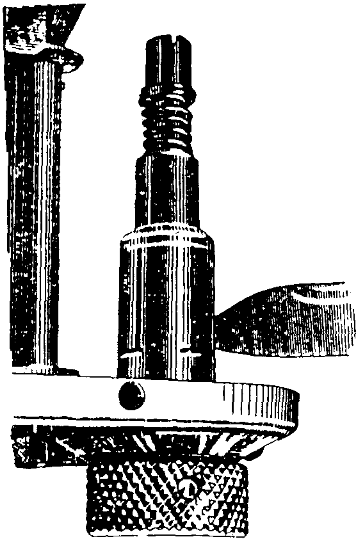


Figure 120. The take-up spool friction clutch.

Sometimes the film coils around the transport sprocket *2* (Fig.131).

To fix this problem, take the mechanism out of the body, cut the film with a blade, and remove it. In addition, check the drum *2* and the spool *4* (Fig.119) by turning the drum in both directions. If the drum turns too easily, remove the drum shaft, take out the spring *1*, and stretch it out a little. Then put the drum back in. Install washers on both sides of the spring *1* and check if the spool fits on the drum tightly. However, it should be installed in such a way that it could be easily taken off the drum with two fingers and removed from the camera. There are special springs for adjusting the spool fit on the drum. To make it tighter, slightly lift the springs (Fig.120) with a knife. If it is too tight and the spool is difficult to get out, press the springs inside.

The spools frequently get lost. New spools should be fitted to the drum because their inside diameters are not always the same. Do not take out the spool by the link *1* on the bottom removable plate (see Fig.117) as many photographers do. Adjust the correct position of the take-up spool which is necessary for normal camera operation.

There is one more possible take-up spool malfunction: after a while the spring plate on the spool that holds the film becomes weaker and cannot hold the film any more. In that case the film end comes from under the spring while the camera is being loaded, and coils around the transport sprocket. Often when the spring is weak, a photographer will fold the film end twice. This is not recommended because while the exposed film is being rewound, its folded end might break off and get stuck inside the body, or it may break the curtain.

The plate of the take-up spool spring is repaired as follows. Cut the heads of the rivets fastening the plate to the spool with a file; get the rivets out using a puncheon. Cut M1.4x0.25 or M1.7x0.35 threads in the rivet holes. Make the holes in the spring slightly larger in diameter than the screws, then fold the spring (brass plate) and fasten it to the spool with screws. Screw fastening is convenient because when the spring weakens again, the screws can be unscrewed, the spring folded, and put back in.

Camera Body

The camera body is made of aluminum alloy and covered with vulcanized rubber. The FED camera has always had a sturdy body. The early modification of the "Zorki" camera body shell lacked strength, but later it was improved.

It should be noted that body shell deformation makes the camera loading more difficult, causes the lens mount ring and, consequently, the lens to warp. There is a special tool for straightening out the body shell. The tool's size corresponds to the interior body dimensions. The body is put on the tool and straightened by light strokes of a mallet avoiding damage to the covering. If the covering is damaged, chips are glued back with shellac. If this special tool is not available, the body can be straightened with the use of any hard object.

Partial Camera Disassembly

Partial camera disassembly is done for moderate or sometimes minor repair of the shutter mechanism and rangefinder, as well as for lens adjustment.

For partial disassembly, remove the top plate *6* (Fig.116) and take the mechanism out of the body *14*. This is done as follows. Take the lens mount ring fastened with four screws off the body. Put the lens mount ring with screws upside down on the bench because there are paper shims under it, and their positions should not be changed in order to preserve the adjustment. The lens mount ring screws go through the holes in the shims and are screwed in the body shell's threaded holes. Memorize the positions of the shims and take them out.

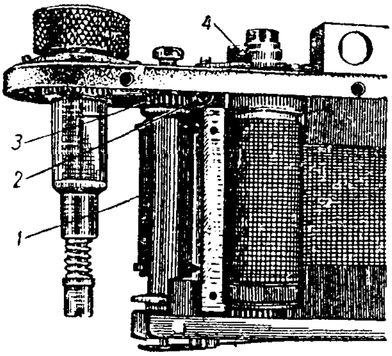


Figure 121. The switch mechanism parts.

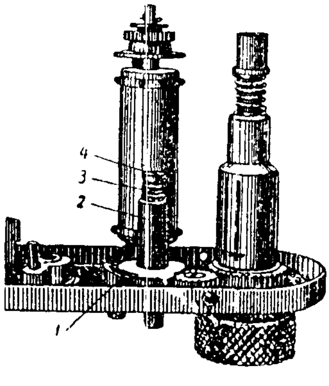


Figure 122. The disengagement gear.

Then unscrew the ten facing screws - four on the front of the body and six on the sides of the assembly plate *3*. In late models of "Zorki", there are only five screws; one of them (rear left) is shorter. Take the shutter mechanism out of the body after turning the lever with the rangefinder cam *12* inside (Fig.127). To remove the top plate *6* (Fig.116), unscrew the two side fastening screws and remove the shutter speed knob *8* by freeing one or two set screws (variations are possible) and removing the accessory shoe *7*. Then remove the eyepieces and optical wedges using special pliers (cupropliers, see Fig.27). The optical wedge consists of three parts: the chromed rim *1* (Fig.158), the bushing, and the mount with the optical wedge *2*. All the eyepieces are joined in one. Then remove the top plate *6* (Fig.116).

Reassembly is accomplished in reverse order.

Mechanism Switch While Loading and Rewinding Film

The mechanism switch when the film is loaded and rewound (Fig.121) serves for disengaging the transport sprocket and the shutter mechanism.

The sprocket *1*, linked with the shutter, pulls the film during winding. To rotate the transport sprocket in the opposite direction while the film is being rewound, it has to be disengaged from the shutter mechanism.

Switching the transport sprocket is done as follows. The disengagement gear *3* turns on the long shaft. The gear can move upward along the release button and become disengaged from other gears. The handle *4* is connected with the cam-switch *2* which is located on the other side of the top assembly plate. When the handle is turned, the cam turns and pushes the gear *3* .

Remember that the cam-switch *1* (Fig.122) disengages the transport sprocket not just from the shutter winding mechanism, but from the curtains mechanism as well.

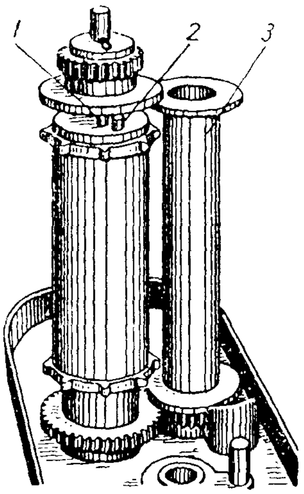


Figure 123. The sprocket and switch bushing sleeve.

The spiral spring *3* lowers the gear *2* and holds it engaged when the handle *4* (Fig.121) is switched to the "On" position.

The sprocket is screwed on top of the gear (Fig.123). It has a pin *2* on its upper end, and this pin hits the pin *1* of the release gear linked with the curtains mechanism. To allow the sprocket to turn freely in the opposite direction, the pins of the sprocket and gear have to be disengaged. The release gear with the pin turns on the shaft. Its shaft is a rod which is an extension of the release button and which runs through the transport sprocket with the release gear on the end. When the mechanism winds, the transport sprocket pulls the film and, simultaneously, rotates the release gear with its pin; this gear winds the curtains mechanism. When the release button is pushed, the release gear is disengaged from the transport sprocket.

When the film is rewound, the release button is not pushed. The disengagement gear *3* (Fig.121) is switched off by the handle *4*. The long tube with a wide flange on its end - the switch bushing sleeve *3* (Fig.123) - is fitted on the disengagement gear. When the gear is pushed with the switch bushing sleeve 3, it pushes the release gear, and the sprocket becomes disengaged from the winding mechanism gears and curtains mechanism.

Switch mechanism malfunctions. 1. ***The handle 4 (Fig.121) fastening screw is loose.*** The handle *4* is set on the square of the cam *2*. Sometimes the handle's fastening screw becomes loose, and then the handle does not function.

Put the handle on the square in any position and tighten the screw.

While the screw is being tightened, the square (cam) goes down and falls inside the mechanism. It is necessary to remove the mechanism from the body, i.e., to do partial disassembly, in order to reinstall the cam. Therefore, try to set the handle in any position and tighten the screw without pushing it too hard with a screwdriver.

When this is achieved, the proper position of the handle can be found by checking the switch operation.

After the handle *4* is installed in the necessary position, put a washer between the handle and the plate *3* (Fig.116).

The cam with the handle should be turned with very little effort. If the cam is loose, it may miss the gear *3* flange (Fig.121) and fail to push it out.

2. ***The disengagement gear is malfunctioning.*** Sometimes (most often in the "Zorki" camera) the spring *3* (Fig.122) becomes weak and the gear *2* gets arbitrarily out of gear during mechanism winding. The gear teeth make a crackling sound, and the shutter cannot be wound, especially when the camera is loaded. Take the mechanism out of the body and check the operation of the gear when the shutter is wound. While doing it, hold the transport sprocket with a finger to simulate the load that the mechanism experiences when pulling the film.

If the gear *2* shifts up the shaft and the teeth slip through, it means that the spiral spring *3* has become somewhat weak. It has to be strengthened by stretching. To do that, disassemble the camera completely (see p.117). Separate the body with the focal plane shutter, and remove the disengaging bushing sleeve *3* (Fig.123) fitted on the bushing *2* (Fig.122). Then remove and strengthen the spring *3* fastened with the screw *4*. Unscrew the screw carefully while holding it, because it may fall out. There is a washer on the shaft between the spring and the gear bushing: the mechanism cannot operate without it. Make sure to remember this washer when removing the spring. The shaft bearing the gear *2* is screwed in the hole at the base; the base is soldered to the assembly plate. Since the shaft can have left or right hand thread (depending on the modification), it may become unscrewed during the installation of the spring *3* and the tightening of the screw *4*. Therefore, do not use much force while tightening the screw *4*. If the shaft is unscrewed, determine the direction of the thread. When tightening the shaft with pliers, put a piece of rubber or some other protective material under the pliers so that they do not leave any burrs on the shaft. Otherwise, the gear *2* will not turn freely. After you have strengthened the spring *3*, install the bushing sleeve *3* (Fig.123) higher up so that its head is right under the gear. In this position, the gear disk prevents the bushing *2* (Fig.122) and bushing sleeve *3* (Fig.123) from moving arbitrarily. To install the bushing sleeve *3* higher up, put two or three washers on the gear bushing under the bushing sleeve base. There is a clamp on the gear *2* (Fig.121); the cam *1* rests on it. Sometimes the clamp becomes bent and then the gear *2* cannot be moved.

The clamp is straightened out without removing the gear with light hammer strokes.

3. ***Incorrect position of the disengagement bushing sleeve (Fig.122).*** The wide head of the disengagement bushing sleeve *3* (Fig.123) is located under the release gear rim. At the turn of the handle *4* (Fig.121), the gear *3* is moved with the bushing sleeve *3* (Fig.123) which, in turn,

pushes the gear *3* (Fig.131) and, in doing this, disengages the pins of the gear and the transport sprocket. Sometimes the flange of the bushing sleeve *3* (Fig.123) moves above the gear *3* rim (Fig.131), instead of under it. In such cases the mechanism gears cannot be disengaged, and the gear *2* (Fig.122) cannot get to its place. This can occur as a result of incorrect loading and unloading of the film when the film or the take-up spool hooks the bushing sleeve and keeps it out of its normal position. In this case, the winding knob rotates endlessly, and the mechanism cannot be wound, just as if it were turned off, regardless of the handle *4* being in the "On" position.

Remove the bottom plate and check the position of the flange of the bushing sleeve *3* (Fig.123). The problem can almost always be fixed without disassembly: pull the bushing sleeve with a screwdriver to put it in its place.

The bushing sleeve *3* has two cuts at the base which control the tightness of its setting on the bushing *2* (Fig.122). There are washers (one or several) underneath the bushing sleeve to adjust its position so that at the turn of the cam *1*, it disengages the pins of the release gear *3* (Fig.131) and the transport sprocket *2*.

Exposure Counter

The exposure counters in the FED and "Zorki" cameras are chromed disks *1* (dials, Fig.124) with division lines. They count exposed frames.

The number of the division lines and the distance between them on the dial are chosen in such a way that each time the shutter mechanism is wound, the dial turns along with the winding mechanism, making the turn one division line short of a complete revolution.

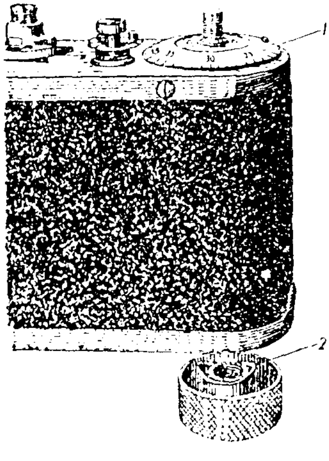


Figure 124. The exposure counter.

Compared to other camera brands, the exposure counters in FED and "Zorki" are the simplest and the most reliable in operation. A brass plate is inserted in the dial hole; then the dial with the plate is loosely placed on the winding gear shaft and tightly pressed with the spring *2* located in the lower part of the winding knob.

The major exposure counter malfunction is a weak dial fastening with the pressing spring *2*. Its displacement results in an incorrect count.

To fix this problem, strengthen the pressure of the spring *2* on the dial. Untighten the set screw by turning it two or three times. Remove the winding knob *12* (Fig.116) while holding the winding gear and the take-up spool drum with your left hand to avoid damage to the brake spring. Put the body without the winding knob on the bench to keep the winding gear *2* (Fig.125) from falling out of the assembly plate *3* bushing (Fig.116).

The spring *2* (Fig.124) has a semicircular shape. Its center is fastened to the winding knob, and its side edges press the counter dial. To make the spring press the counter dial harder, remove it and bend it some more. Once this is done, put it back on the knob screwed on the winding gear shaft, and tighten the set screw.

Brake Spring and Winding Mechanism

While the camera shutter is wound, the springs of the curtains in the bushing sleeves stretch more. The tension force of these springs drives them to the starting position. All mechanism gears turn freely on their shafts so that the curtains can return to the starting position only when the finger releases the knob *12* (Fig.116). To prevent this, the brake spring *5* (Fig.125) is installed. It keeps the mechanism in any position regardless of whether the mechanism is wound completely or partially. The brake spring is a spiral that tightly fits on the winding gear *2* shaft. It is secured in the fixed position. The spring's upper end with the shaped bend is fastened to the top assembly plate with two screws and a lath. To remove the brake spring, the winding mechanism has to be disassembled.

The brake spring's function is not limited to holding the curtains mechanism in the wound position. It has a great impact on the operation of other mechanism parts. If the brake spring does not fix the curtains mechanism in the wound position and the mechanism moves back, the exposure counter dial will also go back, thus working incorrectly.

The technology of the assembly provides for free wheeling for the winding mechanism, equal to approximately half the distance between the division lines on the exposure counter dial. Without it, pushing the release button, would take a significant effort. Reliable operation of the speed mechanism depends on the functioning of the brake spring.

To check the amount of the dial free wheeling, wind the mechanism fully. You should then release the button and determine how far the exposure counter dial returns (i.e., the number of division lines) relative to the arrow on the assembly plate. If the free wheeling is equal to two, three points or more, the spring has to be fixed. The brake spring weakens over approximately a five year period, when the exposure counter is set to zero (all the film loading) counter-clockwise, and when the camera is disassembled or reassembled incorrectly.

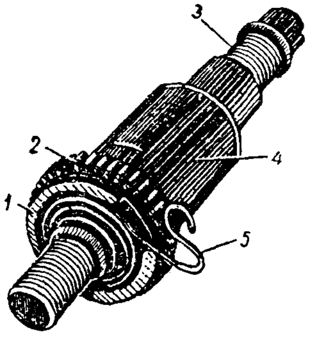


Figure 125. The brake spring.

The spring diameter is slightly less than the diameter of the winding gear shaft bearing it. The spring has 5.5 coils. A worn out spring is easily repaired. If the spring was straightened out as a result of incorrect disassembly, it is almost impossible to repair.

To repair the brake spring, the winding mechanism is disassembled as follows: remove the winding knob *12* (Fig.116), remove the exposure counter dial *1* with a shim (Fig.124), and unscrew the two M1.7x0.35 screws fastening the brake spring *5* (Fig.125) to the assembly plate. Then freely take out the winding gear *2* with the rod and the drum of the take-up spool *4*, and remove the brake ring *1* after memorizing the position of the mark for future reinstallment. The brake will not work without the ring *1*. Then carefully take out the spring trying not to stretch it and wash the winding mechanism with benzine.

Since it is essential for the spring ends to tightly grip the winding gear shaft, you ought to bend the spring ends toward the center.

Reassembly is done in reverse order.

The brake spring of the winding gear shaft and the spool drum of the take-up spring should be lubricated with watch oil.

Speed Mechanism

This mechanism serves for setting the required speed of the focal plane shutter. It consists of the exposure regulator *1* (Fig.126), exposure disk *4*, and engraved knob *8* of the shutter speed mechanism (Fig.116).

The exposure disk *4* (Fig.126) is fixed on the curtains drum shaft. Its number of holes is equal to the number of the shutter speeds. The exposure lever *1* is also fastened to the curtains drum shaft, but it can turn. The engraved knob is fixed on the exposure lever and turns with it.

The operational principle of the focal plane shutter speed mechanism is the following. The release button *6* frees the first short curtain which is then driven by the spring inside the bushing sleeve to reel around the bushing sleeve, thus returning to the starting position. The tape ends of this curtain are glued to the pulleys *5* (Fig.127) and rotate them. The pulleys, in turn, are fixed on the two sides of the drum shaft of the long curtain *7*.

The short curtain moves to the starting position and opens the frame window while rotating the drum shaft of the second curtain where the speed mechanism is fastened. The drum with the second long curtain does not move at this time. Let us consider what keeps it in place. The coupling with the pin *1* (Fig.135), rotating in the assembly plate bushing, is connected with the curtains drum. There is a hole on top of the assembly plate and another hole on the bottom of the shutter body. These two holes (sockets) hold the lever *5* rod (Fig.126). The lever rod is driven by two springs - upper and lower. The lower spring is very strong, while the upper spring is weak. At the push of the release button, its shaft pushes out the shutter spring *4* (Fig.132). The shutter spring also serves as the lever *5* spring (Fig.126). The lever along with the lower spring moves down driven by the upper spring *8*. Thus at the push of the release button, along with the first curtain being released, the lever *5* goes down. Its hook catches the cam *7* and keeps the second curtain in place until the release button is let go. Then the stronger lower spring lifts the lever *5* and frees the second curtain.

This is how the "B" (manual) speed works. ***The exposure regulator function is not involved.***

The width of the slit between the curtains, determined by the period of time between the release of the first curtain and the second one, is controlled by delaying the second curtain. (The sooner the lever *5* releases the second curtain, the narrower the slit between the curtains and, consequently, the lesser the exposure time). This job is done by the speed mechanism.

The exposure regulator *1* has the pin *2* positioned in one of the holes of the exposure disk *4*. The exposure regulator turns along with the exposure disk. On the regulator *1* end there is a pin that hits the lever *5*, shifts it aside, and releases the cam *7* along with the second curtain.

Shutter speed mechanism malfunctions. It is sometimes impossible to align a point with a number on the engraved speed mechanism knob opposite the arrow on the accessory shoe *7* (Fig.116). This may be caused by one of three kinds of problems.

Most often the set screw M1.7x0.35, fixing the position of the engraved speed mechanism knob, becomes loose. To eliminate this problem, wind the shutter mechanism and untighten the set screw of the speed mechanism knob by turning it a few times.

Turn the speed mechanism knob screwed onto the exposure lever until the knob point coincides with the arrow on the accessory shoe. Hold the knob in this position with your left hand thumb while tightening the set screw with your right hand. To make the points on the engraved knob coincide with the actual positions of the holes in the exposure disk, set the knob to the "Z" speed on an old camera modification or to "B" on new modifications. The slow speed "B" is easy to check even without much experience.

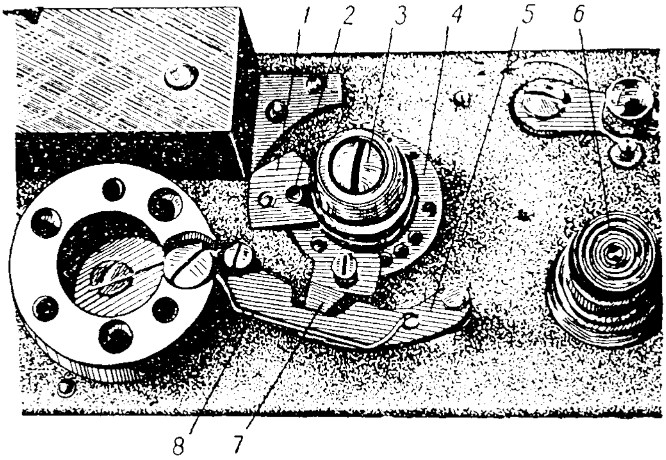


Figure 126. The shutter speed mechanism.

If the engraved speed knob cannot be set opposite the accessory shoe *7*, check the position of the screw *3* (Fig.126) after removing the speed knob. The screw *3* often gets loose. Tighten it well. There is a spiral spring under the screw *3*. Make sure that the spring's end is not squeezed between the wall of the exposure regulator bushing and the head of the screw *3*.

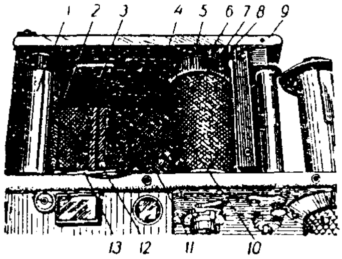


Figure 127. The focal plane shutter in the body.

The third typical malfunction of the speed setting mechanism may be the falling out of the pin *2*. To reinstall the pin, remove the exposure regulator *1* after taking off the top plate *6* (Fig.116) and unscrewing the screw *3* (Fig.126).

Remembering that there is a spring under the screw *3*, you should unscrew it, carefully holding it, so that the spring does not push it out. The misplaced pin *2* is always somewhere under the top plate *6* (Fig.116), so take off the plate carefully.

After you have found the pin, insert it in the exposure regulator hole and secure it by riveting on the reverse side.

Focal Plane Shutter

The focal plane shutter in the FED and "Zorki" cameras has a simple design.

Two light-proof curtains made of vulcanized silk fabric form a slit of a certain width. This slit moves over the frame window and exposes the light-sensitive material (film).

Other than the two curtains with ribbons (Fig.127), the shutter mechanism consists of the curtain *7* drum with the shaft and two pulleys, and the bushing sleeves *1* and *2* with shafts and springs. The entire curtains assembly, or focal plane shutter, is assembled inside the shutter body *6* (Fig.128) made of brass or aluminum alloy. It also holds a brass frame of 24x36 mm size and restrictive gear *1*. The shutter body is fastened with three screws to the top assembly plate *3* (Fig.116).

The curtains assembly is designed as follows (Fig.129). The first short curtain *5* is glued to the bushing sleeve *3* and is called the bushing sleeve curtain. The second long curtain *8* is glued to the drum *11* and is called the drum curtain. On the other end of each curtain there is a metal lath *6*. The ribbons *7* on either side of the lath, are attached to the pulleys *9* by their loose end. The ends of the drum curtain ribbons are glued to both sides of the bushing sleeve *1*.

There is a spiral spring inside each bushing sleeve. Its one end is attached to the shaft and the other to the bushing sleeve. Figure 130 shows the assembled and disassembled bushing sleeve. To disassemble the bushing sleeve, remove the side wall with the attached spring end. The bushing sleeve *1* is somewhat narrower than the bushing sleeve *3*. Two pulleys are fitted on the free surface of the shaft *2*. The ribbons running through these pulleys ensure that the curtains move smoothly during shutter operation. The delay mechanism forms part of the shutter, but it can be repaired without shutter disassembly (see p.121).

Shutter operational principle. While the shutter is wound, both curtains are put in the wound position. The short curtain reels off the bushing sleeve *2* (Fig.127), and its ribbons reel around the pulleys *5*. The long curtain reels around the drum *7*, and its ribbons reel off the bushing sleeve *1*. When the shutter is wound, the springs inside the bushing sleeves stretch considerably.

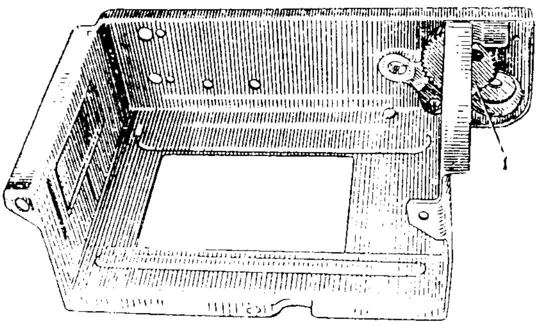


Figure 128. The shutter body.

The working stroke of the curtains is always definite. It is controlled by the restrictive gear *1* (Fig.128) inside the shutter body. A ledged screw functions as its shaft. As the gear turns in both directions, the screw can loosen. To prevent this, the screw has the locking nut *5* (Fig.132) on the other side of the shutter body.

The restrictive gear has a groove inside, the length of which is in agreement with the curtains winding. The screw in the shutter body enters the groove in the gear and thereby constrains its movement.

The restrictive gear acts as an intermediate link between the release gear *3* (Fig.131) and the curtain pulley gear *6* (Fig.127).

When the release button *1* (Fig.131) is depressed, the release button shaft disengages the release gear *3* and allows the curtain to return to the starting position. The short curtain is the first to return. The long curtain returns in some time, controlled by the speed mechanism. The curtains form a slit of a certain width. The maximum slit width is about 40 mm at 1/25 sec speed. The shorter the time, the smaller the slit between the curtains. It is on average about 3 mm at 1/500 sec.

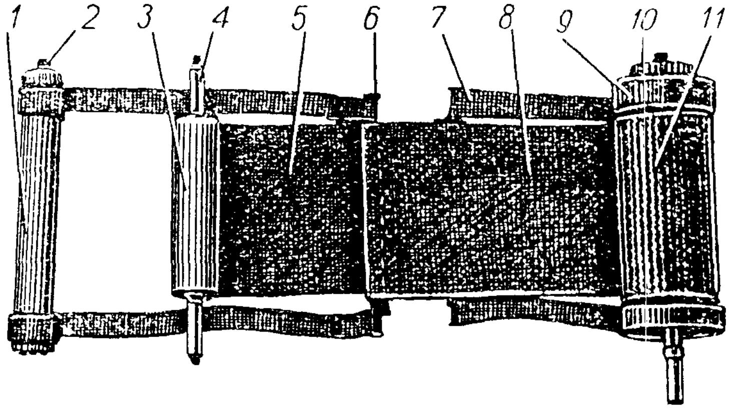


Figure 129. The curtains assembly

Shutter disassembly and reassembly. The focal plane shutter is disassembled after partial camera disassembly (see p.109). First of all, disassemble the shutter speed mechanism. To do that, unscrew the screw *3* (Fig.126) and remove the exposure regulator *1*; unscrew the screw and remove the exposure disk *4*; free the spring *8* and remove the lever *5*. You can now remove the release spring *4* (Fig.132) which is fastened to the lath *11* (Fig 127) with two screws *3* through the holes in the shutter body. These screws also hold the protective set square *10* inside the shutter body. Now is the turn to unscrew the set screws *2* (Fig.132), fastening the shaped nuts *1* with left hand thread. Unscrew the last three screws that fasten the shutter body to the plate *3* (Fig.116). You will find these screws on the side of the shutter body.

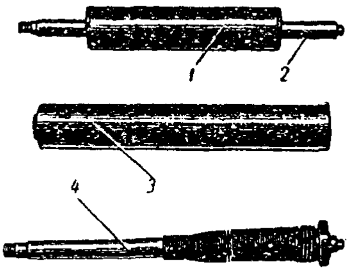


Figure 130. The bushing sleeve with a spring

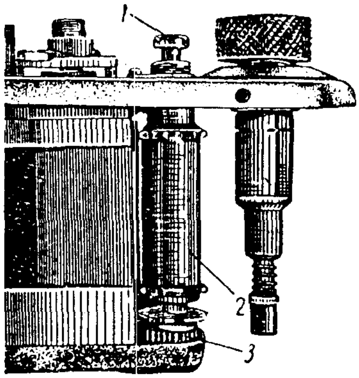


Figure 131. The transport sprocket.

The shutter is reassembled in the reverse order. It is crucial that the curtains be installed correctly, or else the shutter will not work.

The curtains are installed in the shape of the figure of eight (Fig.129), i.e., the second long curtain runs above the first, and its ribbons run under the bushing sleeve shaft 4.

Two pulleys are fitted on the free parts of the shaft *4* of the bushing sleeve *3*: the larger one is near the bottom of the shutter body (Fig.128) and the smaller is near the assembly plate.

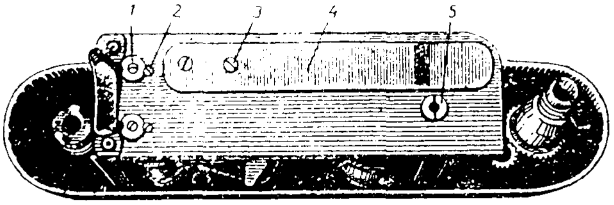


Figure 132. The exterior parts of the shutter body.

The shafts *4* (Fig.129) and *2* should be lubricated. The latest modifications of "Zorki", "Zorki-C", and "Zorki-2C" have a short pulley and a small bushing instead of the long pulley.

The curtains assembly in the shutter body (Fig.128) is installed in the following order. First, put back the shafts of the bushing sleeves *1* and *2* (Fig.127) and screw on the shaped nuts *1* (Fig.132). Then install the shaft of the drum *11* (Fig.129) in the shutter body socket (Fig.128).

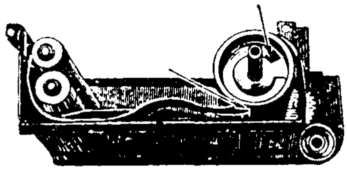


Figure 133. The curtains assembly in the body.

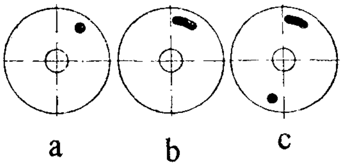


Figure 134. Holes in the drums.

Position the pulley *6* gear (Fig.127) correctly relative to the restrictive gear *8*. This is almost never achieved after a single attempt. Thus, it is first installed roughly and later corrected in the process of assembly. Before installing the drum *7* shaft in the socket, turn the gear *8* clockwise all the way. Then turn the drum *7* with the pulleys *5* counter-clockwise to reel the long curtain around the drum and the short curtain ribbons around the pulleys (as during shutter winding). Install the drum shaft in this position in the socket and link the gears (Fig.133). The Figure 133 shows that the hole in the drum (see upper arrow) is above the remaining part of the pulley disk, and the curtain lath (see lower arrow) is next to the drum.

The number of holes in the drum may vary, and they do not always have the same diameter. The drum may have one round hole (Fig.134a), one elongated hole (Fig.134b), or two holes - round and elongated (Fig.134c). If the hole is elongated, the drum is installed in such a way that part of the hole equal in size to the pin of the coupling *1* (Fig.135) is positioned under the rest of the pulley disk (see Fig.133). If the drum has two holes, the coupling pin should go into the round hole.

After installing the curtains assembly in the shutter body, connect the body with the assembly plate *3* (Fig.116). This complicated process is done as follows: turn the pulleys *5* (Fig.127) clockwise all the way and turn the drum *7* so as to position the hole in it above the rest

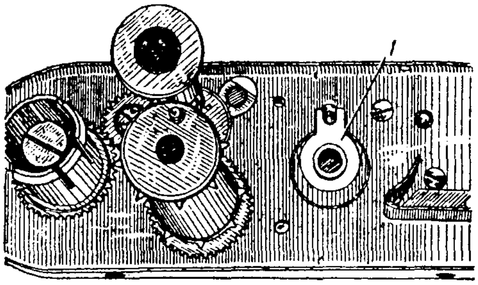


Figure 135. The coupling with a pin.

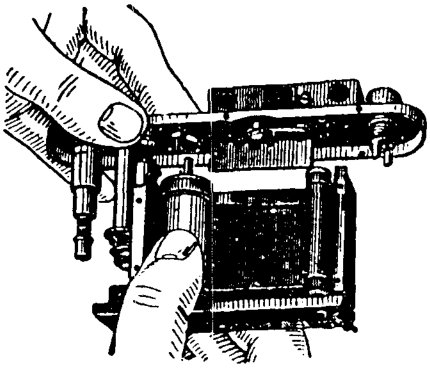


Figure 136. Assembly of the focal plane shutter.

of the pulley disk (Fig.133). After that pick up the shutter body with your right hand, holding the drum and pulleys in place with your thumb, and pick up the assembly plate with your left hand. Prior to that do not forget to turn the coupling *1* (Fig.135) to get its pin in top position. When connecting the shutter body with the assembly plate (Fig.136), make sure that the curtain drum shaft enters the hole in the coupling and the coupling pin fits into the hole in the drum *7* (Fig.127). If after installing the shutter body only one curtain rotates when the shutter is wound, the coupling pin is in the drum hole under the pulley disk and not above it. In that case you will have to repeat the assembling.

After the shutter body and the plate are connected, tighten the left screw of the body fastening. Then install the shafts of both bushing sleeves in the assembly plate holes and tighten the right screw. Wind the curtain springs turning them 3.5-4 times to the left, tighten the locking screws *2* (Fig.132), wind the shutter, reinstall the lever *5* (Fig.126), and check the position of the cam *7*. If it is not centered in the lever slot as shown in Figure 126, the pulley *6* gear (Fig.127) is incorrectly installed relative to the restrictive gear *8*. Remove the shutter body and shift the pulley *6* gear by one or two teeth in either direction. The gear *8* will not move.

After correct installation of the cam *7* (Fig.126), tighten the third screw of the shutter body fastening and check the backlashes of the drum, pulleys, and bushing sleeves. The backlash in the shafts of the drum and pulleys should barely be noticeable. To control it fully, use the washers on the shaft between the pulley *6* gear (Fig.127) and shutter body. The same backlash should be between the drum *7* and the pulleys *5*. It is important that the restrictive gear *8* turn freely. (It is checked before assembling the curtain assembly.)

Now install the shield *10* (Fig. 127) and the release spring *4* (Fig.132) after bending the latter from the center to the sides. The shield *10* is installed in such a way that its edges do not touch the curtains of the bushing sleeve and drum. At this point it is necessary to adjust the shutter speeds (see p.121). First, adjust the "B" speed. Then set the exposure disk *4* (Fig.126) and exposure regulator, and adjust the remaining speeds. Their work depends on the extent to which the springs are stretched in the bushing sleeves.

This process requires extensive experience. The manufacturer adjusts the speeds using a special instrument. In repair shops, experienced specialists adjust speeds by ear and by eye. It is harder for a layman. First, as it was mentioned before, wind the bushing sleeves shafts turning them 3.5-4 times, and check 1/25, 1/50, 1/500 sec speeds. If these speeds work correctly, so will all other speeds.

When checking the slowest speed - 1/25 sec, observe how the curtains move. If both curtains or one of them move slowly, wind the curtain's spring by turning it halfway.

When checking 1/50 sec speed, note the drum with the second curtain during shutter release. The drum *7* (Fig.127) is located near the wall of the shutter body. If during the shutter operation the curtain is even slightly overlapping, it become temporarily hitched to the body wall. It is delayed for a fraction of a second, and this results in uneven frame exposure. Curtain overlapping (which can be observed during shutter checking) must be eliminated by adjusting the degree of winding of the curtain's spring. The second curtain's winding (drum curtain) should be slightly increased or else the first curtain's winding (bushing sleeve curtain) should be decreased. Usually the second curtain's winding should be increased.

At 1/500 sec speed (the fastest) the entire frame surface should be exposed evenly. It is best to observe the boarders of the frame window, i.e., its edge lines. If the lines are sharp, the mechanism is working properly; if one of the lines is blurred, the mechanism needs adjustment. If the left border line is blurred, wind the first curtain's spring more because the second curtain catches up with the first one. (The shutter is viewed in the position when the control knobs are on the bottom, the release spring is on top, and the cam *12* is facing the reader.) Turn the shaft and the nut *1* of the first curtain halfway (Fig.132), and check the shutter operation at 1/500 sec speed. Adjustment is repeated until the frame borders appear sharp. Then all the speeds are checked again.

The speeds are easy to adjust if all the rubbing surfaces of the focal plane shutter are lubricated and the bushing sleeves and curtain drum have sufficient backlashes. Pay particular attention to the curtain drum shaft backlash. Some features of the curtain adjustment are discussed below.

Most common focal plane shutter malfunctions. 1. ***Slow curtain movement*** indicated by dark overexposed negatives. When the lens is removed, you may discover that the curtain moves too slowly. This is usually due to the dirty mechanism or dried out lubricant, and is common for cameras that were not used for a number of years. In that case the mechanism requires cleaning and lubrication (see p.38).

2. ***At some speeds the second curtain does not return to the starting position.*** The reason for this malfunction is the same as for the slow curtain movement. In addition to cleaning and lubricating the mechanism, wind the curtain springs by turning them 0.5-1 times.

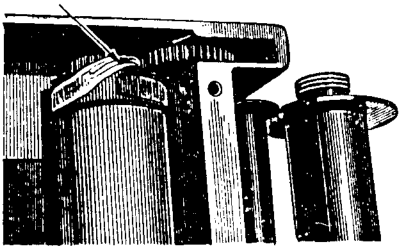


Figure 137. The ribbon is stuck between the teeth of the gears.

Similar symptoms are observed if the broken off pieces of film are stuck in the mechanism. In that case, take the mechanism out of the body and remove the pieces of film.

3. ***The short curtain ribbon gets stuck between the teeth of the gears.*** This is one of the most common shutter problems.

The short curtain ribbons are glued to the pulleys. There are two gears next to the pulley *5* (Fig.127) - pulley *6* gear and restrictive gear *8* where the ribbon gets stuck between the teeth.

The reason for this problem is that only one ribbon coil is glued to the pulley *5*. All the rest of it just reels around the pulley, and when the tension weakens it easily slides from the pulley in between the gear teeth.

This is caused by incorrect and unskillful camera handling, extracting an incorrectly loaded film, incorrect film loading, or shield *10* deformation (Fig.127). With its edge, the deformed shield catches the curtain, usually the short one, and breaks the smooth reeling of the curtain around the bushing sleeve. The ribbon stretch weakens, it falls off the pulley and gets between the gear teeth. Besides, the shield edge breaks the rubber coating of the curtain and makes the curtain unusable. The shutter stops functioning. With the removed lens, the displaced short curtain can be seen. During the winding of the shutter, the ribbon first runs along the pulley and then turns toward the gear (Fig.137). In that case you should stop shutter winding immediately to save the ribbon.

4. ***The lever catch does not work, and the "B" speed is not functioning.*** The lever catch *5* (Fig.126) malfunctions and the "B" speed failing are closely related (see p.114).

The "B" (manual) speed is working arbitrarily, i.e., it can have any rate and is equal to the time the release button is being depressed. At any automatic shutter speed the lever releases the second curtain with the aid of the exposure regulator *1*. At the "B" speed the exposure regulator 1 does not affect the lever because it does not reach the catch. The lever goes up and down driven by two springs.

As you push the release button, the lower spring *4* (Fig.132) goes down; the lever driven by that spring goes down as well and detains the second curtain. The shutter is open, while the frame window is completely exposed. Once you let go of the release button, the lower spring is freed and lifts the lever which in turn releases the second curtain. As it follows from the above, the "B" speed functioning is closely related to the operation of the lever *5* (Fig.126); malfunctions of the "B" speed are caused by malfunctions of the lever and exposure regulator *1*.

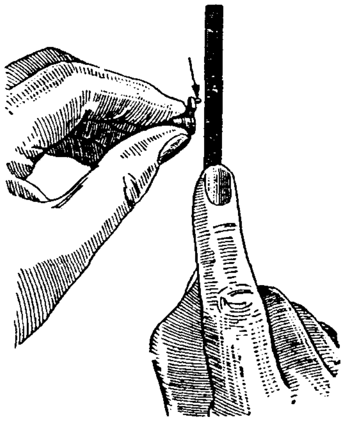


Figure 138. Fixing the exposure lever pin.

The lever *5* consists of two parts: the rod and the catch. Sometimes the catch fixed on the rod becomes loose and, therefore, cannot be adjusted. To secure it, place the rod on a metal surface and rivet the rod and catch joint; try to avoid bending the rod.

The coupling *1* (Fig.135) has the cam *7* (Fig.126) on the outside of the assembly plate. The cam 7 is linked to the second long curtain drum *7* (Fig.127) by the coupling *1* (Fig.135) and its pin.

The cam *7* (Fig.126) is securely fitted on the coupling *1* square. If the cam *7* is poorly secured, it cannot be adjusted. Thus check the condition of the lever *5* and cam *7*. If both are in good condition, it means that the "B" speed is not working because of the poor adjustment of the lever *5*.

Lever adjustment is important for correct and reliable functioning of the speed mechanism (see details in "Speed Mechanism"). The catch is very thin, the cam *7* has the same thickness as the catch. When the shutter mechanism is wound, the cam *7* turns along with the coupling *1*, and the lever is in the upper position.

At this time the cam *7* runs under the lever catch. If the release button is pushed, the lever catch will come down and the shutter will trip, i.e., the first curtain will return to its starting position, and the second curtain will be halted by the lever catch. When the lever catch comes down, the cam *7* must get into the catch groove and stay there. If this does not happen, take out the lever catch and file off a small part of the rod end.

There is one more reason for the "B" speed malfunction. As it was explained above, the exposure regulator *1* pin affects the lever at all speeds except "B". It is possible that the exposure regulator *1* pin reaches the catch at the "B" speed too. This could be caused by sloppy curtain gluing and, consequently, improper position of the restrictive gear. To avoid regluing the curtains which is complicated and too difficult for a layman, make the exposure regulator *1* pin a little thinner. To do that, remove the exposure regulator and file the pin a little (see arrow in Fig.138).

Sometimes the "B" speed functions properly, and the regulator *1* pin does not reach the lever catch, but after installation of the engraved speed knob *8* (Fig.116) the "B" speed stops working. It happens because the speed knob makes the exposure regulator heavier and increases its turning time due to the backlash in the exposure regulator *1* (Fig. 126) and the exposure disk *4*.

5. ***Loose restrictive gear screw.*** The restrictive gear *1* (Fig.128) is fastened with the ledged screw and jam-nut *5* (Fig.132) to the shutter body. Sometimes the screw gets loose, the engagement between the restrictive gear and other gears breaks, and the shutter stops functioning. The shutter winding is no longer limited, and one can hear the gear making crackling sounds.

To fix this problem, disassemble the shutter, install and secure the gear. If the jam-nut *5* fell off, it must be screwed back on. While disassembling the shutter, do not release the curtain springs and do not take the bushing sleeve out of the body.

6. ***Sometimes one part of the frame gets more exposure than the other.*** This happens at 1/50 and 1/500 sec. Adjustment methods for these speeds are discussed on p.120, but sometimes other problems occur as well. For example if the spring of the second curtain is wound too much, the latter catches up with first curtain, and part of the frame remains dark. This can be eliminated by adjusting the curtain springs tension. Part of the frame may also remain dark when the camera is dirty and the curtains move slowly.

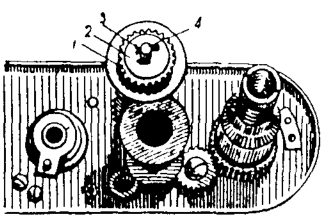


Figure 139. The release gear.

7. ***Release gear 3 (Fig.131) malfunction.*** One of the problems with the release gear is when the cotter pin *3* (Fig.139) falls or breaks off. In that case the mechanism cannot be wound up all the way because in the middle or at the end of the shutter winding the curtains snap and return to their starting position.

If the pins of the transport sprocket and of the release gear (see Fig.123) disconnect, the curtains return to the starting position. The pins can disconnect arbitrarily if one of them is broken or if the release gear *1* is displaced. The gear *1* (Fig.139) is installed on the release shaft *4*, and the black washer *2* is placed on top. The gear *1* is fastened with the cotter pin *3*. When the cotter pin is broken, the gear shifts along the release shaft, and its pin does not connect with the transport sprocket pin or connects only partially. This results in the curtains arbitrarily returning to their starting position.

To repair the damage, make and install a new cotter pin. If the cotter pin is intact, but the gear *1* fits the shaft too loosely, remove the cotter pin and put one or two washers between the washer and the gear.

Release gear malfunction can also be caused when the shutter body (Fig.128) is deformed and the release shaft *4* (Fig.139) does not reach the release spring *1* (Fig.140). The butt-end of the release shaft *2* has to be on one level with the bottom of the shutter body (see arrow in Fig.140). If it is a little lower, slightly bend down the edge of the shutter body.

The gear *1* (Fig.139) consists of two parts: the disk with a shaft and the gear. The gear is screwed on the disk shaft. The parts are joined together by the pin inserted in the holes in the disk and the gear. When the pin gets loose and falls out, the gear unscrews, so when you push the release button there is no shutter release. To eliminate this defect, remove the release gear from the shaft *4*, tighten it until the holes in the disk and the gear coincide, and insert a new pin. You can also make a M1.4x.25 thread in the hole and screw in a set screw.

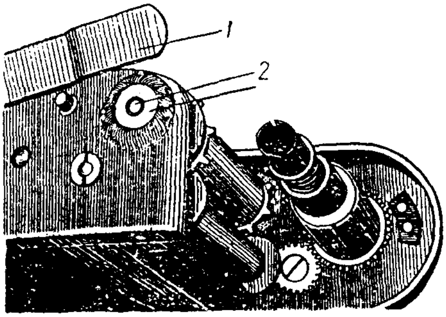


Figure 140. The release button shaft.

The method of the gear *1* installation and adjustment is described above.

8. ***Light penetration through the curtains.*** If you discover an exposure spot on a negative, study it carefully and find out the reason for it.

Fog from sun specks is possible if a lens hood was not used during the shooting in the sun. A fog spot has semicircular shape and relatively large size which is not characteristic of light penetration through the curtains.

Light fog can be caused by different curtain defects: if ribbons are glued incorrectly, one of them is stretched more than the other, and curtain lath warp causes a gap to develop between the curtain laths which are meant to overlap. Fog in the shape of small dots from the needle holes appears where there is a stitch seam. The holes in the curtains are caused by tiny pieces of film stuck inside the mechanism, by burns from photographing the sun or a solar eclipse.

If the film is loaded incorrectly, it does not move in the film track. It is removed without rewinding into the cartridge.

When the film is pulled, the shield *10* (Fig.127) often becomes deformed. The shield's edge scratches the curtain and hurts the rubber coating which damages the curtains and causes the shutter to malfunction.

Minor damage (punctures and small holes) can be glued and covered with flat black paint. If the damage is significant, the curtain has to be replaced.

9. ***Unglued ribbons.*** Each curtain has a lath with two ribbons attached. Often as a result of wearing out or incorrect handling, the ribbons unglue from the bushing sleeve *1* (Fig. 129).

The shutter disassembly and reassembly process and ribbon gluing are described below. Remember that the ribbon on the bushing sleeve should be glued in parallel to the pulleys.

If the ribbon is torn off near the lath *6*, sew it together and cut off part of the second ribbon to make them the same length.

10. ***Worn out curtains.*** The curtains become unfit as a result of natural wearing out or incorrect camera operation.

Natural wear is manifest when the curtains' rubber coating dries out, cracks, and falls off. A cracked curtain is pervious to light and inflexible; it disrupts normal shutter operation.

Curtain wear is common for the FED cameras manufactured before World War II and for the first "Zorki" cameras.

Curtains replacement requires complete camera disassembly (see p. 120). It is much easier to glue on new curtains when the position of old curtains is marked. The marks are made on the drum at the place where the long curtain edge was glued on. They are also made on the pulleys where the short curtain ribbons were. Do not make any other marks because the positions of the short and long curtain ribbons are not important. Before gluing on the new curtains and ribbons, make sure that they have the same size as the old ones. Glue the curtains and ribbons with non-thick shellac starting with the drum curtain and the bushing sleeve curtain. Make sure that the curtain has no warp and is positioned at the same distance from the edges of the drum and bushing sleeve. After gluing the curtains on the drum and bushing sleeve, reel them and place them underneath a heavy object to keep them reeled; let them dry for 15-20 min.

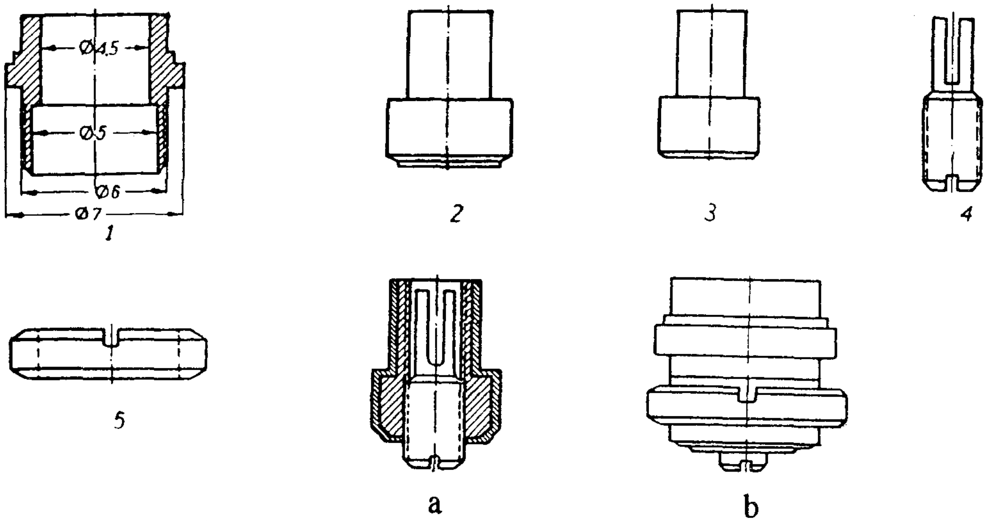


Figure 141. Parts of the flash socket.

You can now glue the ends of the long curtain ribbons to the bushing sleeve *1* (Fig. 129). The bushing sleeve must be strictly parallel to the curtain lath *6*. Then glue the ends of the short curtain ribbons to the pulleys *9*. Do not forget that only one coil of the curtains and ribbons should be glued on.

Having glued on the ribbons, start camera reassembly at once before the glue has set so that the ribbons can be reglued if necessary. If the old positions of the curtains and ribbons cannot be marked, exact curtain gluing becomes difficult and often has to be redone.

Reel the long curtain around the drum and set it in the shutter wound position (see Fig.133). The hole in the drum (see arrow in Figure 133) is positioned above the rest of the pulley disk, and the curtain lath (see lower arrow) is right next to the drum. Change the curtain's position on the drum until it is set as shown in Figure 133. After both curtains and the ends of the long curtain ribbons are glued to the bushing sleeve, glue the ribbons' ends to the pulleys *9* (Fig.129). To glue them correctly, set the drum in the position shown in Figure 133 and glue the ribbons to the pulley so that the long curtain lath covers 1/2-3/4 of the short curtain lath.

In drums with elongated holes (see Fig.134), only part of the hole equal to the coupling *1* pin diameter (Fig.135) should be left above the pulley disk (see arrow in Fig.133).

Sometimes the curtains and the ribbons unglue when the coupling pin becomes loose and falls out, the restrictive gear is damaged, etc. In these cases the curtains are glued back on as described above.

Making and Installing the Flash Synchronization Mechanism

All the FED and "Zorki" cameras were manufactured without a socket for the flash.

The flash synchronization device is installed as follows. Remove the camera body *14* (Fig.116), drill a hole in its outer part, insert a flash socket, and fasten it with a nut from the other side.

Camera repair shops receive the flash sockets from the plants. Lay people can make them as follows: make a cylindrical brass tube (Fig.141) - a flash socket case 7.5 mm long with a 4.5 mm inside diameter and 7 mm outside diameter. Cut a M6x0.5 thread 4 mm long. The second part of the flash socket is the contact *2* brass bushing. The bushing height is 6 mm, the outside diameter of the top part is 3 mm, the bottom part diameter is 5 mm, the bottom part height is 2.5 mm. The inside diameter of the body *1* bottom part is also equal to 5 mm. The bottom part height is not 2.5 but 3 mm. The reason for it is that after inserting the bushing *2* in the flash socket case, the 0.5 mm tall case butt-end should be rolled to prevent the bushing *2* from falling out.

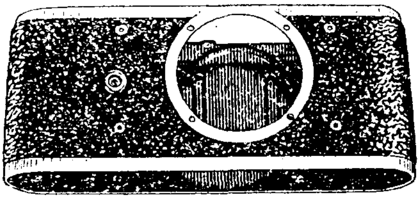


Figure 142. The flash socket on the camera body.

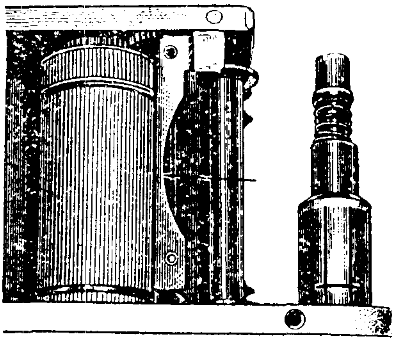


Figure 143. The cut out in the shutter body.

Install the 6 mm long ebonite bushing *3* with a 2.5 mm top part diameter and a 4.5 mm bottom part diameter into the bushing *2*. The bushing can be made of other insulating materials as well. Cut the thread inside the bushing *3* for screwing in the interior contact.

The brass contact *4* is 5 mm long with the top diameter of its exterior part being 1.5 mm. Cut a 2 mm long M2x0.4 thread in the contact bottom part. Drill a 3 mm long hole with a 1 mm diameter in the contact top part; make a slot for a screwdriver on the bottom part. Then cut the contact with a hand-saw and screw it in the ebonite bushing *3*.

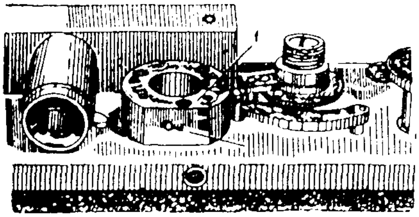


Figure 144. The accessory shoe base.

Assembled parts *2*, *3*, and *4* are shown on Figure 141a. Figure 141b shows an assembled flash socket.

Install the flash socket in the right side of the body (top view) between the holes for fastening the screws, somewhat to the right of the line connecting the holes (Fig. 142). Then make a semicircular hole in the shutter body (Fig. 143) between the fastening screws. You should then drill a 1.5-1.8 mm hole in the shutter body (see arrow) for the electric cord. Having finished preparing the shutter body, cut off part of the disk *1* (Fig. 144) after removing it from the assembly plate *3* (Fig. 116). The base has six holes with the threads for M1.7x0.35 screws. Three screws fasten the base to the assembly plate. The accessory shoe *7* is fastened to the base with three screws as well. Slots for the screws which fasten the base to the assembly plate are located under the set square *10* (Fig. 127). Put the removed base in a vice and saw off about 1.5-2 mm. Then drill a hole (see arrow in Fig. 144) and cut a M1.7x0.35 thread. The hole should be located somewhat to the left of the base center. Drill a 1.5-1.8 mm hole (see arrow in Fig. 146) in the assembly plate for the electric cord.

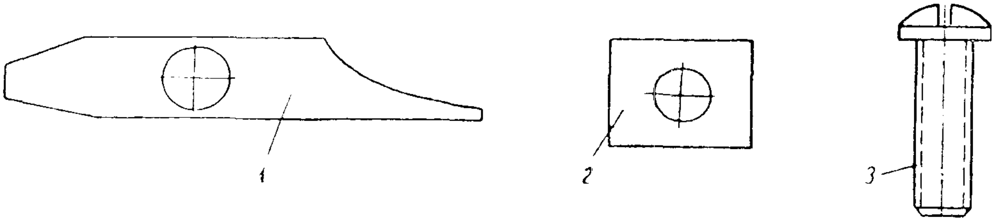


Figure 145. The parts of the contact mechanism.

Now assemble and adjust the entire camera (except for the body and the exterior shield). All that remains to be done is the installation of the contact mechanism consisting of the brass spring *1* (Fig. 145), two gitinax insulating shims *2*, and fastening M1.7x0.35 screw *3*. To make the spring, take a piece of brass foil 0.15-0.20 mm thick and cut it according to the shape shown in Figure 145. Drill a 2.3-2.5 mm hole in the spring, make 1.8 mm holes 1 mm thick in gitinax shims.

The contact mechanism is installed as follows: place the spring *3* (Fig. 146) between the shims *4* and fasten it to the disk on the assembly plate with a screw. The hole in the spring *1* (Fig. 145) is significantly larger than the fastening screw section, and the spring is easy to install so that it is insulated from the body and the screw. Position the thin end of the spring so that when the mechanism is wound (at 1/25 sec speed), the lever *2* (Fig. 146) turns and runs under the end of the spring *3*.

Then finish reassembling the camera and solder the connecting electric cord (a thin 150-200 mm long one-strand wire in polyvinyl insulation). Solder one end of the wire to the insulated contact of the flash socket and direct it through the holes in the shutter body (see arrow in Fig. 143) and assembly plate (see arrow in Fig. 146). Next install the springs and the support disk *5* (Fig. 119). Insert the mechanism in the body. Having done this, tighten the ten facing screws, stretch the wire, cut off the excess, and solder the end to the left side of the contact spring *3* (Fig. 146).

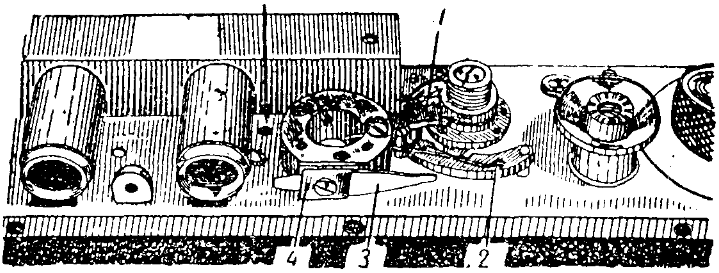


Figure 146. The contact mechanism.

The flash synchronization operational principle is as follows: when the shutter is wound (at 1/25 sec speed), the exposure regulator *1* pin shifts and turns the lever catch *2* which runs under the end of the spring *3* and closes the electric circuit.

When the release button is pushed and the shutter trips, the lever *2* catch comes down and, simultaneously, it is turned by the exposure regulator *1*. The catch *2* shifts and touches the end of the spring *3* which closes the electric circuit. This occurs at the moment when the first curtain returns to its starting position and the frame window is completely open.

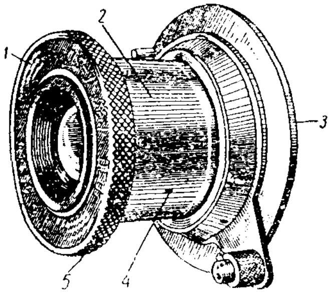


Figure 147. The "Industar-10" lens.

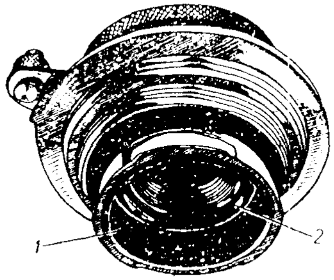


Figure 148. The lens mount.

The flash socket can be installed in a simpler way on the top plate *6* (Fig. 116) below the sign "Zorki". In this case it is not necessary to make a semicircular hole in the shutter body and to run the electric cord through the two holes. However, it is not always possible to install the flash socket on the top plate without damaging the sign. If the sign consists of one word (see Fig. 116), there is some space for an flash socket, but some modifications have a sign that fills up the whole top plate. So be careful not to damage this sign.

"Industar-10" Lens

The FED camera is equipped with the "Industar-10" lens (Figures 147, 148) which is a four-element lens semi-glued anastigmatic. The lenses manufactured before 1952 were uncoated, those made after 1952 were coated. The optical diagram of the lens is shown in Figure 149.

Specifications

Focal length	50 mm
Relative aperture	1:3.5
Field angle	46°
Distance scale range	from 1 m to ∞
Resolution in lines per 1 mm:	
in field center	35
on field edges	19

The "Industar-10" lens contains a system of lens elements in a mount (block) and an exterior mount.

The mount consists of the exterior ring *1*, barrel *2*, and multi-entry thread *3*. A disassembled lens is shown in Figure 150a, b.

The lens block consists of the front lens element *2* (Fig.150a) which is installed in the socket of the second lens element mount and secured with the threaded ring *1*, mount *3* with the fixed (rolled) second lens, diaphragm *4* tang connected by two screws *5* to the diaphragm crown inside the block between the second and third lens elements, block base *6*, and mount *8* with the fixed (rolled) third and fourth lens elements which are cemented together.

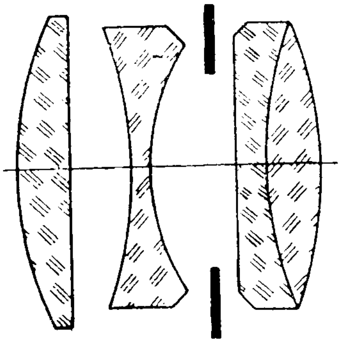


Figure 149. An optical diagram of the "Industar-10" lens.

Lens disassembly. It is recommended that you read the chapter "Photographic Lens" before attempting to disassemble or repair the lens. The disassembly sequence for "Industar-10" is the following: remove the ring *1* (Fig.148); unscrew the fastening nut *2*; unscrew the screw *4* (Fig.147); insert a screwdriver in the hole *5* and unscrew the screw under the patch; unscrew the exterior ring *1* and, simultaneously, remove the lens block and the barrel *2*.

The lens block is disassembled as follows (Fig.150a). Using a key, unscrew the front lens element threaded ring *1*. (If the mount with the lens elements also gets unscrewed, remove it and unscrew the front lens element threaded ring.) Carefully remove the front lens element; unscrew the mount *3* with the second lens element; unscrew the screws *5* and remove the tang *4*; unscrew the mount *8*.

If the mount multi-entry thread is being disassembled, unscrew the screw *10* (Fig.150b). For proper multi-entry thread disassembly (to find the correct thread entry), position the upper part of the multi-entry thread mount *11* so as to place the handle 13 at a 90° angle to the lock flange on the thread bottom part *9*. You can now start screwing it in.

Lens adjustment is done only in exceptional cases when it is necessary to change the lens working distance. For this purpose, the adjusting rings *7* (Fig.150a) are present on the "Industar-10" lens block. Early lenses had non-standard working distances (within 28.3-28.5 mm) and usually lacked adjustment rings.

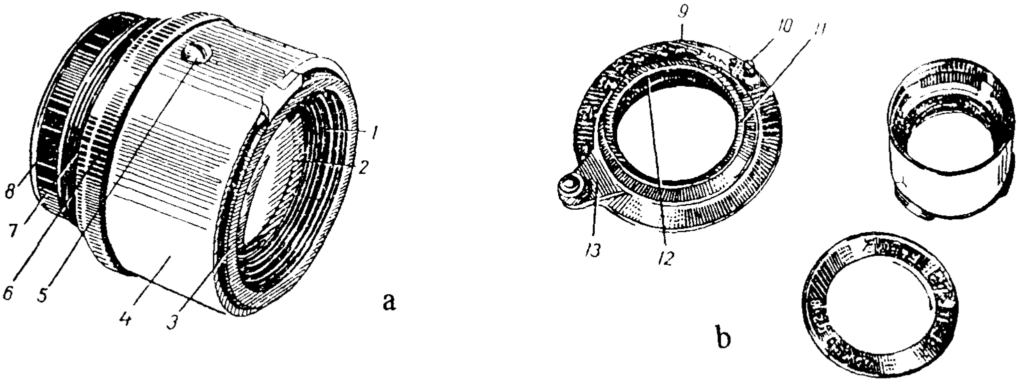


Figure 150. The disassembled "Industar-10" lens:
a - the lens block; b - the exterior mount.

When adjusting the lens, you will be able to get the necessary working distance by combining the adjusting rings of different thickness. The working distance is measured by a special tool described on p.132. To adjust the lens, disassemble it partially as described above.

Malfunctions and their elimination. 1. ***A "Fog" on the lens elements.*** The most common problem with the uncoated "Industar-10" lens is that it may become foggy or form the so-called fog visible with the naked eye on the lens elements. The third lens element becomes foggy the most often.

The fog forms as a result of moisture condensing during prolonged lens heating in the enlarger or due to an abrupt environmental change. For example, it may form after operation in cold air. To remove it, take out the light-proof ring *1* (Fig.148) and unscrew the mount *8* with the lens elements (Fig.150a). Remove the fog the same way as you usually do when you clean the camera lens (see p.31). Lastly, reinstall the mount *8*.

2. ***Damaged lens mount thread.*** If the lens is screwed into the camera incorrectly, the lever bearing the rangefinder cam becomes deformed. This causes the cam to hit the guide thread instead of the butt-end of the lens mount. It damages the thread and makes it impossible to set *1* m on the range scale; the scale is limited to 2-1.5 m. Having discovered the damage, take the lens out of the camera and slightly bend the lever *13* (Fig.127); put the cam *12* back in its place and repair the thread. The multi-entry thread is repaired with a three-edged or rhombic file.

3. ***The mount turns with great difficulty or jerkily.*** This problem occurs as a result of accumulating dirt or drying out multi-entry thread lubricant. When the lubricant is applied, the mount will rotate normally. Do not disassemble the mount because the lubricant is applied on the thread edges.

4. ***Backlash in the mount multi-entry thread.*** This lens malfunction impairs the lens coupling with the rangefinder. It is caused by a natural wearing out of the multi-entry thread. It is impossible to eliminate the problem completely, but a thick lubricant improves thread function.

5. ***The lens barrel moves in the lens too freely.*** The mount *11* contains the stuffing box *12* (Fig.150b) (leather shim). To fix the problem, disassemble the lens and glue a thin paper strip under the stuffing box. Slightly turn the barrel during installation.

"Industar-22" Lens

The "Industar-22" lens (Fig.151) which is installed on the "Zorki" camera is a four-element lens semi-cemented anastigmatic. The lens optics are coated.

Specifications

Focal length	52.4 mm
Relative aperture	1:3.5
Field angle	45°
Distance scale range	from 1 m to ∞
Resolution in lines per 1 mm:	
in field center	32
on field edges	20

The "Industar-22" lens design is similar to the design of the "Industar-10" lens. The shape of the diaphragm tang and the disassembly order are slightly different. To remove the block from the mount, do not disassemble the mount and do not unscrew the exterior ring (Fig.147). It is sufficient to unscrew just the fastening nut *2* (Fig.148) and the screw *4* (Fig.147).

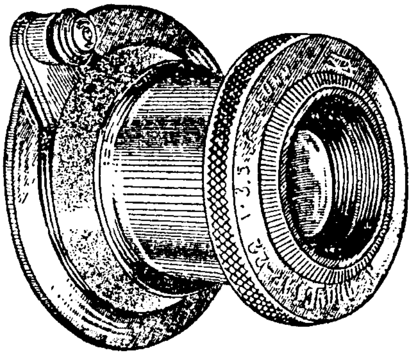


Figure 151. The "Industar-22" lens.

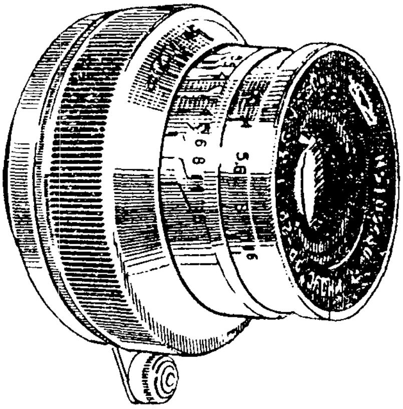


Figure 152. The "Industar-22" lens in a non-telescopic mount.

All the malfunctions and repairs of the "Industar-22" lens are similar to those of the "Industar-10" lens.

A small number of "Zorki" cameras were equipped with the "Industar-22" lens in a rigid (non-collapsible) mount (Fig.152). This design is complicated, and it is not recommended to disassemble the lens. The collapsible mount has one multi-entry thread, and it is not difficult to assemble, but the non-collapsible mount has several threads two of which are multi-entry. Its assembly requires certain skill.

When the collapsible mount rotates, the entire lens and all the scales turn with it including the diaphragm scale. During the rotation of the rigid mount, the lens does not turn but only moves in the direction of the axis. Therefore, the scales of the diaphragm and the depth of the field do not change their positions. This is more convenient in operation.

Lens design. To understand the lens design, remove the ring with the range scale (Fig.153). It is fastened with three screws. When the lens mount is turned all the way, the clicks of the restrictive screw *4* hitting the edge of the groove in the ring *3* can be heard. Therefore, the mount turn is limited. If the mount is turned in both directions by the handle *8*, the lens block will move back and forth. Its movement is directed by the screw *2* inside the slot of the ring *3*. The butt-end of the mount *1* that transfers the motion to the camera rangefinder cam also moves together with the block. The ring *6* is fixed. The diaphragm tang *7* comes off with the block if the fastening nut in the back of the lens is unscrewed.

Lens malfunctions. There are two common lens mount malfunctions: 1. ***The mount does not turn smoothly or not at all.*** This happens when the lubricant in the mount threads dries out. To fix this problem, remove the ring (see Fig.153) and apply the lubricant on the multi-entry thread and on the screw *2* groove. Do not disassemble the mount completely. As a last resort, set the ring *5* fastened with three set screws in the ∞ position, and remove it.

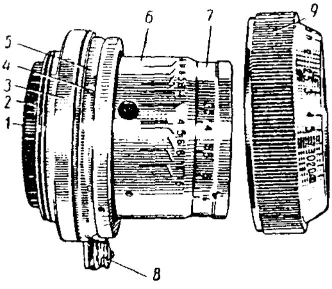


Figure 153. The lens mount parts.

2. ***The restrictive screw 4 becomes loose.*** This screw is a very important part of the lens mount. When it loosens, the rings and multi-entry threads are displaced, and the lens stops functioning. However, the screw *4* should not be tightened all the way because its butt-end will rest against the bottom ring and the mount will not be able to turn. The ring *9* above the screw prevents it from unscrewing. Keep in mind that the screw butt-end may get deformed or the edges of the groove supporting it can become worn away.

If this should happen, remove the ring *9* immediately and reinstall the mount. It is also possible to tighten the screw periodically.

When screwing the lens into the camera, do not push the handle *8* too hard.

All other lens malfunctions and lens adjustment are the same as for the "Industar-10" lens.

Camera Adjustment

Adjustment of this camera group is described in the most detail because the method and tools are applicable to most 35 mm cameras regardless of their rangefinders (reflex or base) and whether they have a removable back cover. The camera adjustment principle is described on p.18.

The FED and "Zorki" camera adjustment is done in two steps: the body and lens adjustment and the rangefinder adjustment.

Body and lens adjustment. During the body and lens adjustment, the camera working distance is set according to the lens working distance. Both distances are measured with the aid of two easily made instruments. The use of the instruments is required for this camera group design because they do not have a removable back cover unlike the FED-2 camera where the cover can be replaced with ground glass if adjustment done by a non-professional. However, these tools can also be used for the adjustment of the FED-2 type cameras with a removable back cover.

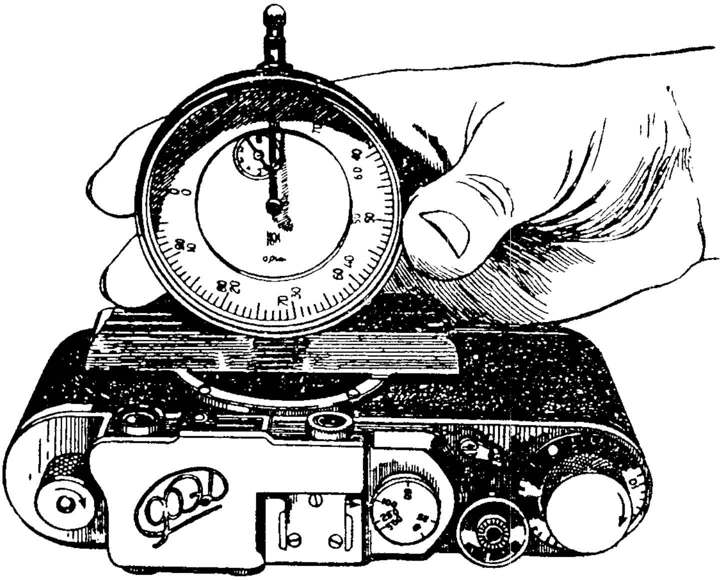


Figure 154. The installation of the indicator.

The first instrument is an indicator (Fig.154, 155) for measuring the camera's working distance. Its operational principle is the following: the traveling rod *3* (Fig.155) is mechanically connected to a needle indicating the value being measured by the rod's shift. The indicator can be purchased, but it has to be modified prior to use. First of all, make a metal cross-piece *1* (Fig.155) 12 mm thick and 18 mm wide; its bottom plane must be absolutely straight and polished to make a good contact with the lens mount ring on the body. To secure the cross-piece on the indicator, drill a hole in it, fit it on the indicator base, and affix it with the set screw *2*.

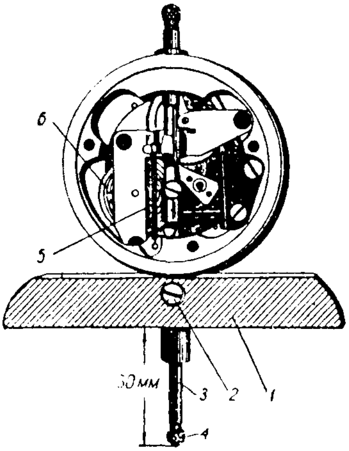


Figure 155. The indicator parts.

The bottom part of the rod *3* has a thread with the tip *4* screwed in. If the traveling rod *3* of the indicator is pushed upward, the tip *4* will move up. If it is released, the rod driven by the spiral spring *5* inside the indicator will return to its starting position. The distance between the end of the tip *4* and the bottom plane of the indicator cross-piece should be close to 30 mm. The needle should point to zero. Do not shift it because it may turn the indicator's rotating dial. Adjust the strength of the spring driving the rod *3* to the starting position. To do that, disassemble the indicator mechanism by unscrewing the three screws and removing the back plate. While measuring the camera's working distance, the indicator rod rests against the support pressure plate *5* (Fig.119) covering two relatively weak leaf springs. For correct measurement of the camera's working distance, the indicator rod should not push out the support pressure plate. This malfunction is possible when the indicator spring is weaker than the springs under the support plate. The spring *5* (Fig.155) cannot be adjusted, so it has to be removed. In addition to the spring *5*, the indicator mechanism contains the spiral *6* which is similar to the spring of a clock's pendulum. It ensures the smooth motion of the rod *3* and is strong enough to drive the rod to the starting position. (The indicator has to be vertical during the measurement.) The spiral *6* is much weaker than the springs under the support plate.

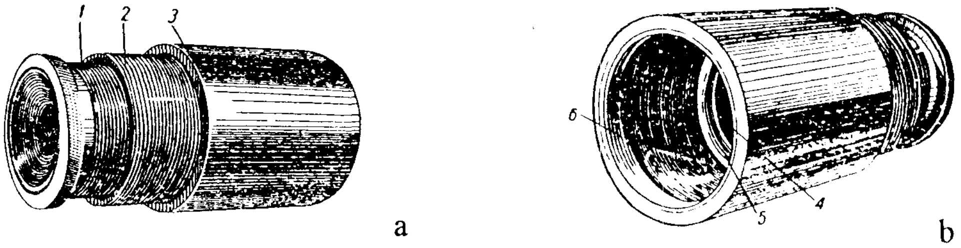


Figure 156. Device for lens working distance measurements:
a - side view; b - front view.

To measure the lens working distance, another instrument is needed besides the indicator. Manufacturers use complex instruments - collimators. We will call our home-made instrument an adjusting device.

This device consists of three tubes: *1*, *2*, and *3* (Fig.156a) with threads for connecting and shifting these tubes relative to each other. The tube *1* has an eyepiece for convenient viewing. (The eyepiece is optional.) The end part of the tube *3* has a thread *6* (Fig.156b) for screwing in the measured lens. The ground glass *4* is installed in the front part of the tube *2* and is secured with the ring *5*. The ground side of the glass is facing the measured lens. A four- to six-fold magnifier is installed inside the tube *1*. The magnifier's position depends on its focal length. Position the magnifier in a way that enables you to see a sharp image of the ground glass surface structure in the eyepiece by shifting the tube *1* in the tube *2*. It is best to make this device out of brass.

Screw the lens in the thread *6* for measuring the working distance. Turn the tube *3* until the image of the indefinitely distant objects (at a distance of more than 100 m) is the sharpest on the ground glass. Then unscrew the lens, install the indicator the same way as for the camera working distance measurements (see Fig.154), and measure the lens working distance. To keep the tubes *2* and *3* in place while unscrewing the lens, lubricate the thread between them with a thick lubricant or install a stop in the form of a screw with a wide head.

The "Industar-22" lens working distance is equal to 28.8±0.02 mm. The early "Industar-10" lenses had a non-standard working distance varying between 28.3-28.5 mm. The late "Industar-10" lenses had the same working distance as the "Industar-22" lens. That is why the interchangeable optics in the FED camera can utilize the optics from the "Zorki" camera type.

The described method can be applied to measure working distances of the "Industar-10", "Industar-22", "Industar-50", "Industar-26M", and "Jupiter-8" lenses, as well as all other interchangeable lenses.

Having measured the lens working distance, measure the camera working distance and adjust it accordingly to the lens working distance. Remember that the film in the frame window bends toward the inside of the camera. Thus, the camera working distance must be set 0.03-0.05 mm larger than the lens working distance. Currently, the accepted film bend in the FED and "Zorki" camera types is equal to 0.03-0.05 mm, and a 0.01-0.03 mm film bend is considered acceptable in the "Zorki-3" and "Kiev" camera types.

Let us say that the measured "Industar-22" lens working distance is not 28.8 mm, but 28.9 mm. Do not adjust the lens in this case. Just set the camera working distance according to the lens working distance. However, if the camera is used with the standard working distance interchangeable optics, the lens has to be adjusted, i.e., all lenses (main and interchangeable) should have the same working distances.

It is not necessary to disassemble the camera for setting the working distance. The camera working distance is controlled by the correct positioning of the lens mount ring *4* (Fig.158) relative to the film plane provided that the shutter body plane where the film moves is absolutely straight. As a rule, there are adjusting paper shims of different thickness from 0.03 to 0.3 mm between the lens mount ring and the body; these shims are made of cardboard and rice paper. The correct position of the lens mount ring with respect to the film plane can be adjusted with these shims.

Measure the camera working distance on four sides - near each of the four screws fastening the lens mount ring. Try to find the position where the indicator readings are equal on all sides; the tolerance is ±0.03 mm.

The body and lens adjustment accomplished by this method is more precise than adjustment by a magnifier and a ground glass in cameras with a removable back cover (for example, "Zorki-3", and FED-2).

If the device for measurement of the lens working distance cannot be made and the indicator is not available, the body and lens adjustment is done as follows.

If the object is not sharp enough on the negative, find the area of the best sharpness - in the front or in the back. To do that, set (as a step-ladder) five magazines or books with crisp, distinct letters. Make the distance between the "steps" about 5-10 cm. Take a picture of this arrangement from a distance of 1.25-1.5 m. Focus the camera on the middle "step". Then there will be two "steps" in the front and two in the back. Set the lens mount according to the distance measured between the camera body back wall and the middle "step".

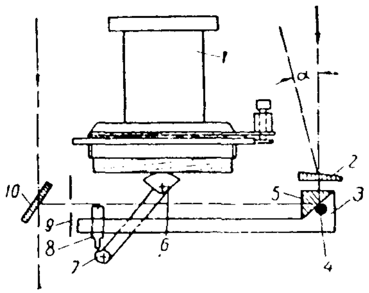


Figure 157. The rangefinder diagram.

Having taken this picture, it is easy to determine where the best sharpness is. If the best sharpness is in the back, move the lens out; if it is in the front, lower the lens. In this case, remove one shim from under the lens mount ring and check the lens operation again. After several attempts, an exact adjustment can be achieved.

If the lens has to be removed, install the shims that are about 0.10 mm thick. Good material for this purpose would be black paper from photo paper envelopes.

The lens adjustment on the body can be checked by the "marks"-method. Take a picture of a newspaper or magazine page (with different font sizes) from 1.5 m distance at different lens positions: a) pulled out relative to the exact measurement; b) according to the exact measurement (from the back wall of the camera body to the object plane); c) lowered relative to the exact measurement.

The object plane should be perpendicular to the lens optical axis. The lens is removed or lowered by the twist of the lens tang.

An index shift on the range scale by 1 mm (in circumference) equals a 0.02 mm axial lens shift. View several negatives through an enlarger and determine the necessary lens shift.

Rangefinder adjustment. Every camera with a rangefinder is considered better and more precise than a camera without one. The rangefinder is coupled with the lens and serves for the precise setting of the distance to the object. Therefore, its correct functioning is very important.

A rangefinder (Fig.157) consists of the beam splitting glass plate *9* coated with a thin gold layer (semi-transparent mirror), reflective prism *5* secured on the prism *3* lever, optical wedge *2*, cam with the lever *6*, cam *7*, screw *8*, and diaphragm *9*. The rangefinder base is 38 mm.

The rangefinder operational principle is as follows: beams reflected by the object pass through the beam splitting glass *10* and in the viewing window. Some beams getting to the prism *5* are also reflected to the mirror *10* and then in the viewing window. Therefore, there are two images of the viewed object in the viewing window: one is viewed directly through the mirror, another is reflected from the prism *5*. Due to the diaphragm *9*, the reflected image is half the size of the directly viewed image.

Focusing is done as follows: The lens *1* is shifted on the mount with the multi-entry thread. The butt-end of the mount traveling part pushes the cam *6* linked to the cam *7* by a lever. The cam turns and pushes the end of the screw *8*. The screw 8 which is secured on the prism *3* lever turns the lever. Thereby, the prism *5* on the lever *3* changes its position relative to the fixed mirror *10*. The lens mount is turned until both images viewed in the viewing window coincide.

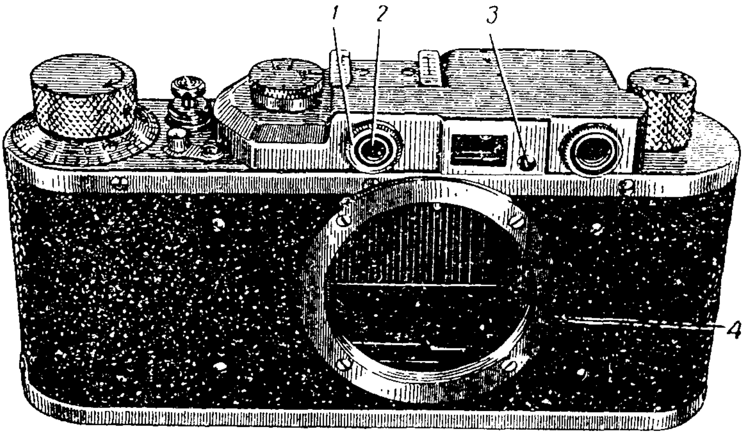


Figure 158. The camera exterior parts.

The diagram of the "Zorki" camera rangefinder is the same as that of the FED camera, except for the cam *6* shape.

To check the accuracy of the rangefinder, point the camera to an indefinitely distant object such as a thin antenna mast at a distance of 100 m or more.

Rangefinder repair. The following tools are needed for rangefinder repair: watch tweezers, cupropliers, and two screwdrivers with a blade width of 1.2 and 2.5 mm.

The rangefinder has many adjusting screws and parts, but it is often easily repaired even without removing the top plate *6* (Fig.116).

Vertical rangefinder adjustment is done by the optical wedge 2 (Fig.157, 158). Remove the chromed optical wedge rim *1* (Fig.158) which is screwed onto the socket where the mount with the optical wedge is tightly inserted. The socket has two holes on opposite sides for the tool used to screw the socket into the rangefinder base. The rotating mount with the optical wedge also has two holes on opposite sides. With the tweezers tips or with the key inserted in the mount holes, turn the optical wedge until both images coincide vertically. A cross-line target drawn on a piece of white paper placed at a distance of 1-2 m from the camera or a sign across the street can be used for this purpose. If the mount with an optical wedge rotates in the socket too easily, take it out with the tweezers and look at the part located inside the socket. It has a cut forming two support dove-tails; straighten them a little and insert the mount back in the socket. Make sure that the optical wedge itself does not turn in the metal mount because it has to be rolled still. If the vertical adjustment cannot be done with the optical wedge, disassemble the entire rangefinder (see p.109).

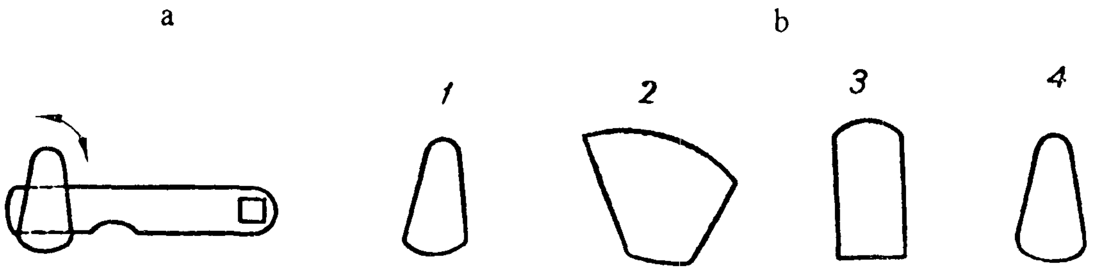


Figure 159. The cams of the rangefinder:
a - lever with the cam; b - shapes of cams: 1 - the cam of the early "Zorki" camera; 2 - the cam of the late "Zorki" camera modifications; 3 - the cam of the early FED camera; 4 - the cam of the late FED camera modifications.

Having finished the vertical adjustment with the optical wedge, also check the horizontal adjustment by focusing on an infinitely distant object (see the above). Set the lens mount handle so that the knob is fixed in the lock; then the mark on the mount will stop opposite the ∞ sign. Having set the lens in the ∞ position, unscrew the side screw *3* (Fig.158) with a wide screwdriver and insert a narrow screwdriver into the screws' hole. Slightly turn the screwdriver and find the slot of the shaped screw *8* (Fig.157). Rotate the screw in one direction or the other depending on the position of the second moving image. If it does not reach ∞, tighten the screw; if it goes too far, loosen it. This is done until both images (moving and still) of the indefinitely distant object coincide.

After that check the rangefinder at the 2-4 m distance. Using a measuring tape, measure 1.2 and 4 m from the back wall of the camera and draw a cross-line target on a piece of white paper. Focus the rangefinder on this target and check the readings on the lens range scale. If they deviate from the actual values, the rangefinder is still not adjusted. In that case continue the range adjustment by turning the cam *12* (Fig. 127) no more than 3-5°. If the reading exceeds the actual distance, turn the cam up; if it is less than the actual distance, turn the cam down (see arrows in Fig. 159).

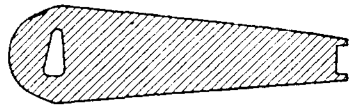


Figure 160. The special tool.

Figure 159 shows different shapes of the cam. To keep the cam in the necessary position, it is tightly secured on the lever 13 (Fig. 127). It is best to turn the cam with a special key which can easily be made out of a metal plate with the dimensions of approximately 20x50x1 mm. Make a hole the shape of the FED or "Zorki" camera cam on one end of the plate for turning the cam (Fig. 160). Make two tips for tightening the optical wedge socket. If such a key is not available, turn the cam gently with pliers. If the cam is secured poorly, the rangefinder will lose its adjustment very soon. To check how well the cam is secured use the key or your hand. If the cam is secured well, it cannot be turned by hand.

Turn the cam by 3-5° in the proper direction and adjust the rangefinder again focusing on an infinitely distant object and an object 1 m away from the camera. Repeat that until the rangefinder readings for infinity and 1, 2, and 4 m become equal to the lens range scale readings. Permissible deviation on the scale is 0.5-1 mm for 1, 2, and 4 m distances to the object; the readings should be absolutely identical for the infinitely distant object.

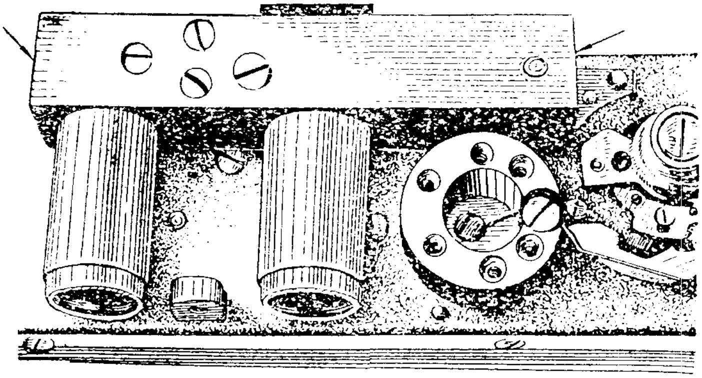


Figure 161. The rangefinder.

For more complicated rangefinder repair, remove the top plate (see p. 109). To get a better understanding of the function of the rangefinder parts and their purpose, refer to the principle diagram (Fig. 157) and Figure 161 where the rangefinder is shown without the top plate.

If the vertical convergence cannot be achieved with the optical wedge, remove the top plate and continue the adjustment to establish the reason for the non-convergence of the verticals. The beam-splitting mirror *10* plane (Fig. 157) must be parallel to the reflecting facet of the prism

5. (The prism's reflecting facet has a mirror coating.) Displacement of the mirror and prism parallel planes occurs for two reasons: strong impact or shock and poor fastening of the mirror and the prism. The prism is glued with shellac to the lever *3* groove. The mirror is fixed, and the lever with the prism turns horizontally relative to the mirror plane and is fixed in a vertical position.

There are several ways of readjusting vertical parallelism of the mirror and the prism.

1. Using four locking controlling screws. To do that, remove the shellac glued protective plate (see right arrow in Fig.161). The plate covers the prism lever fastened with four screws (M1.7x0.35) on the shaft *4* (Fig.157). Untighten each screw, turning it once. Match the images vertically retightening the screws one by one, to be able to adjust the rangefinder later with the optical wedge. Finally, screw in the optical wedge without replacing the top plate *6* (Fig.116) and check the vertical convergence of the images.

2. Checking the position of the mirror. It the first method fails, check the position of the mirror *10* (Fig.157). The mirror is removed as follows: take off the protective plate (see left arrow in Fig.161); remove the spring hooked by its edges to the sides of the mills; remove the mirror housing; gently pick up the edge of the mirror with tweezers and pull it out. Check whether the mirror is intact and put it back. Then reinstall the mirror housing and the spring making sure that the spring holds the mirror housing tightly. Slightly moving the mirror may improve the vertical adjustment. The mirror is replaced in the same way.

3. Heating the prism lever. If the second method fails too, ignite a piece of dry alcohol and use it to slightly heat the prism lever. The glue will melt, and the prism can be put back in correctly with the help of tweezers. This is how rangefinder adjustment is accomplished.

Reinstalling the top plate with the engraved sign and reassembly of the other parts are both done in the reverse order.

Tips on Operation of FED and "Zorki" Cameras

FED and "Zorki" cameras are very easy in operation.

The required shutter speed should be set (by turning the speed knob *8*, Fig.116) only when the shutter is wound. There is an arrow on the accessory shoe *7*. The numbers corresponding to a required shutter speed, engraved on the speed knob, stop opposite this arrow. Do not turn the speed knob in the "B"-"500" interval past the arrow on the accessory shoe; turn it from "B" to "500" and back only past the numbers on the knob. Do not change the shutter speed knob setting when the shutter is partially wound.

The "D" (slow) speed can be used with early cameras without any special device on the winding knob. To do that set the "B" (Z) speed, push the release button, and while holding it turn the switch *10* lever.

Film advance control is done as follows: during the shutter winding, the film wind knob *1* (Fig.118) turns opposite to the direction of the arrow engraved on it. When the film is rewound into the cartridge, its advance can be monitored by the rotating rim *9* (Fig.116). If a few frames need to be rewound, it helps to remember that one complete turn of the rim *9* corresponds to the length of one frame.

Never cut part of the exposed film when the lens is removed and the shutter curtain is open because it may damage the support plate *5* (Fig.119) which would result in scratches on the film.

"ZORKI-2"

The "Zorki-2" camera (Fig.162) is an improved modification of the "Zorki" camera. The camera is equipped with an automatic shutter release mechanism. The speed setting knob, the disengaging mechanism at film rewind, and the bottom plate lock are changed. The camera is equipped with a two-cylinder split cartridge and strap lugs for the neck strap. The lens used is the "Industar-22". Specifications of the "Zorki-2" camera are the same as those of the "Zorki" camera.

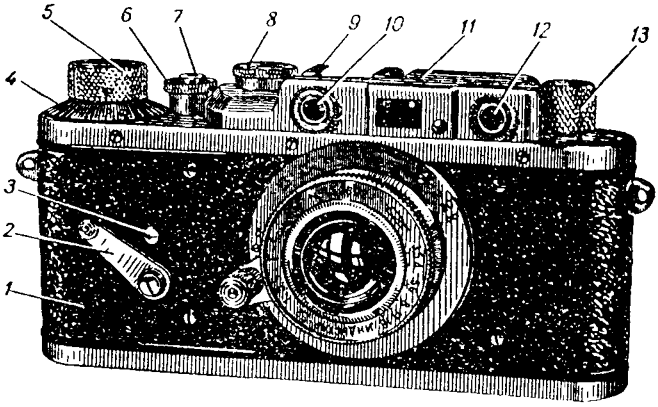


Figure 162. The "Zorki-2" camera.

Major Exterior Camera Parts

The camera consists of the body *1* (Fig.162), selftimer lever *2*, release button *3*, exposure counter dial *4*, knob *5*, film rewind disengagement mechanism knob *6*, shutter release button *7*,

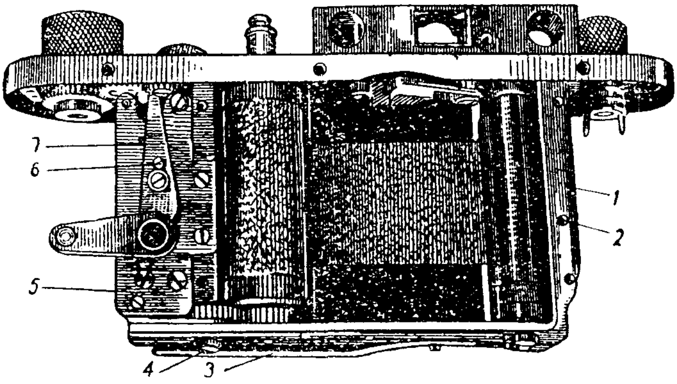


Figure 163. The focal plane shutter and the selftimer.

shutter speed setting mechanism knob *8*, accessory shoe *9*, optical wedge *10*, top plate *11*, rangefinder front protective glass *12*, and film rewind knob *13*.

Camera Disassembly

Due to changes in design, the sequence of disassembly and reassembly has changed. To remove the mechanism from the body, in addition to the facing screws, unscrew the screw fastening the selftimer lever *2*. The lever *2* is fitted on an adapter square with two pins for linking it to the delay mechanism. The screw is fitted through the adapter.

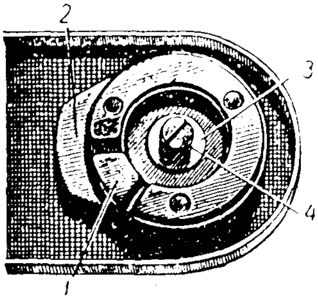


Figure 164. The lock of the removable plate.

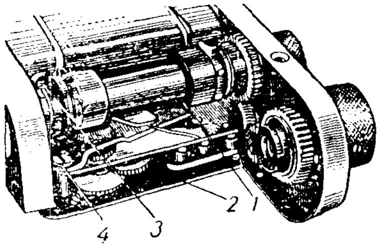


Figure 165. The selftimer mechanism parts.

Having removed the lever and the adapter, unscrew the release button *3* with pliers. The release button is a screw with an arrow on its head. The rangefinder base is fastened with three screws.

The shape of the release spring *3* (Fig.163) has been changed. The current modification has a special hole for the release gear groove. The shutter body *1* is fastened with three screws as in the "Zorki" camera. The screw in the hole *2* enters the shoe groove of the split cartridge. The restrictive gear (see p.122) is fastened with the screw *4*. The design of the shutter speed mechanism knob *8* (Fig.162) is the same as in the "Zorki-C" camera.

Bottom plate lock serves to lock the plate of the camera and, simultaneously, open and close the cartridges. The two-cylinder split cartridge opens when the plate lock closes. The lock design and assembly are not complicated. The lock consists of a base with an outside bracket and four parts located inside: the washer-catch *1* (Fig.164) opening the cartridge, lock washer *2*, washer *3*, and screw *4*. The bottom of the washer-catch *1* has a cam for shifting the lock washer *2*. To disassemble the lock, unscrew the screw *4*.

Mechanism switch. The "Zorki-2" camera switch mechanism is somewhat different from the "Zorki" camera switch design because the switch is located in the place where the delay mechanism is installed. However, its operational principle is the same, i.e., the transport sprocket 1 (Fig.165) is not linked to the delay mechanism gears or to the release gear. The design, malfunctions, and repair of the switch mechanism are described in detail on p.145.

Selftimer

The selftimer (Fig.163, 165) serves for automatic shutter release, and it is a delay mechanism linked to the shutter mechanism. The delay mechanism is located on the shutter body and fastened with three screws. The parts of the delay mechanism are covered with a protective plate from inside. The plate is fastened with three screws: two on the exterior (the exterior is shown in Fig.163) and one on the interior. Figure 165 shows the delay mechanism without the protective plate; the friction clutch bearing the take-up spool is also removed.

The delay mechanism is driven by a relatively strong spiral spring positioned under the transport sprocket *1* (Fig.165) and wound by turning the lever *2* (Fig.162). The delay mechanism release is done by the button *3* in the hole *6* (Fig.163) on the lever *7*. When the lever *7* releases the pallet, the delay mechanism starts working. The operational time of the delay mechanism is 10-15 sec. During its operation, the intermediate lever *3* (Fig.165) fastened with the screw *4* is shifted. With its pin the intermediate lever pushes the release spring *3* (Fig.163), moves the spring out and causes an automatic shutter release.

The delay mechanism can be stopped by the handle *2* (Fig.162). The turning of the handle shifts the button *3* to the starting position.

The current delay mechanism design is slightly different, and all later cameras are equipped with standard delay mechanisms. Their design is described in detail in the chapter on "Zorki-2C".

The "Zorki-2" camera selftimer repair can be done after studying the "Zorki-2C" camera selftimer repair.

"ZORKI-C"

The "Zorki-C" camera is an improved modification of the "Zorki" camera. "Zorki-C" has a flash synchronization mechanism with a synchrocontroller. The flash synchronization installation with its mechanism being located under the top plate initiated changes in the shape and size of the top plate. In addition, "Zorki-C" also has a totally different switch mechanism of the film rewind transport sprocket. This necessity to make room for the selftimer mechanism accounted for the next modification - the "Zorki-2C" camera.

Slight changes were made in the design of other parts, but in general the "Zorki-C" camera duplicates the "Zorki" camera. It is, therefore, recommended that you read the "Zorki" camera description before studying its next modification.

"Zorki-C" is equipped with the "Industar-22" lens in a collapsible mount (see p.130).

Major Exterior Camera Parts

The camera consists of the body *13*, flash socket 1 (Fig.166), exposure counter dial *2*, winding knob *3*, mechanism switch 4, release button *5*, shutter speed knob *6*, optical wedge *7*, accessory shoe *8*, top plate *9*, rangefinder front protective glass *10*, film rewind knob *11*, and top assembly plate *12*.

Top Plate and Partial Camera Disassembly

The size of the top plate is close to that of the top assembly plate. The flash synchronization socket is located on the left side of the top plate. For partial "Zorki-C" camera disassembly, remove the top plate and take the shutter mechanism out of the body (see partial disassembly of the "Zorki" camera). It is done as follows: unscrew the eyepieces.of the viewfinder and rangefinder, the rangefinder front protective glass *10*, and the optical wedge *7*; free the accessory shoe *8* (unscrew only the lower right screw of the accessory shoe fastening); unscrew the set screws and remove the shutter speed knob *6*; unscrew the set screw and remove the synchrocontroller lever (set the lever at zero position before removing it, and put it back at

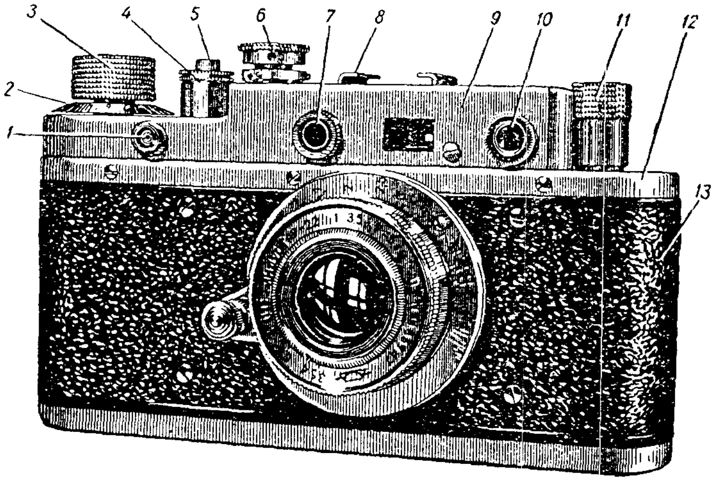


Figure 166. The "Zorki-C" camera.

assembling); unscrew the set screw and remove the rim of the release button *5* used for film rewind; unscrew the set screw and remove the winding knob *3*; remove the exposure counter dial *2* and the shim under it; unscrew the two fastening screws under the counter dial; unscrew the side screws on the plate.

After disassembling and reassembling the parts and removing the top plate, check the rangefinder adjustment.

Shutter Speed Mechanism

The design of the shutter speed mechanism of the "Zorki-C" camera is more complex than that of the "Zorki" camera. The shapes of the parts were changed, and one more function was added - the flash synchronization circuit closing.

In the "Zorki" camera, the exposure regulator *1* (see Fig.126) is fastened with a wide-headed screw. There is a spring underneath the head, while the shutter speed knob *8* (Fig.116) is

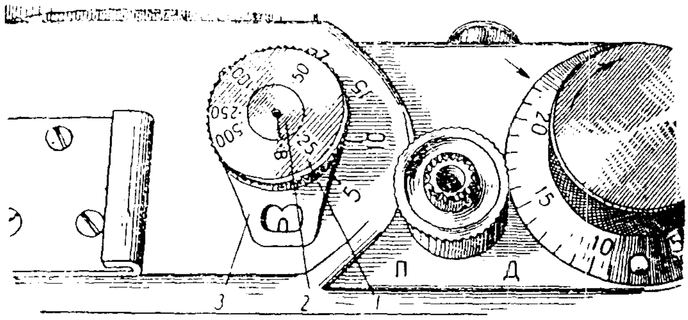


Figure 167. Shutter speed knob.

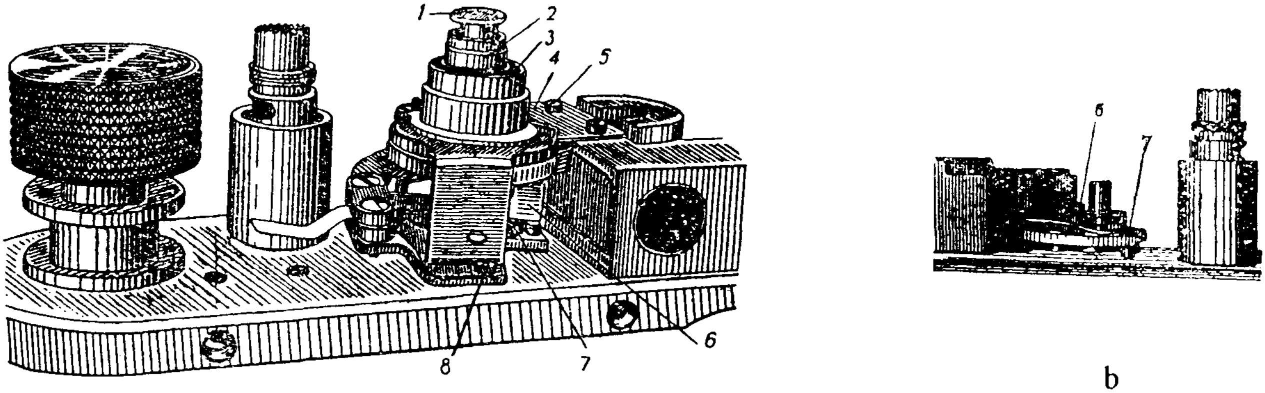
installed above. In the "Zorki-C" camera, the exposure regulator *2* (Fig.168a) is positioned slightly higher, and the screw *1* of the regulator fastening enters the hole in the speed knob *1*

(Fig.167). While the required shutter speed is set, the knob rotates on the shaft-screw *2*. In the "Zorki-C" camera, the speed knob can be set when the shutter is in the unwound position. The screw *2* has a through hole for a steel brad. Do not tighten the screw with pliers.

Malfunctions and repair of the "Zorki-C" camera speed mechanism are the same as in the "Zorki" camera.

Flash Synchronization Mechanism

Due to the synchrocontroller, the "Zorki-C" camera flash synchronization can be used not only for a flash, but for disposable bulbs as well (see p. 29).



a

b

Figure 168. The flash synchronization mechanism:
a - general view; b - with the bracket removed.

The flash synchronization mechanism's socket is positioned on the left side of the top plate *9* (Fig.166); the contact mechanism and the synchrocontroller are under the plate.

If the contact mechanism has to be removed for repair of parts, try to avoid displacing the synchrocontroller.

The contact mechanism (Fig.169) is a system of contacts and insulating shims located on the special bracket *2* fastened with three screws. The system of contacts is arranged in such a way that when the shutter trips the electric circuit closes in two places at once (main contacts and interlocking contacts).

The bracket *2* also supports the synchrocontroller. The latter consists of the movable disk *1*, restrictive pin *3*, and contact fastened on the movable disk under the bracket. To install the bracket with the contacts correctly, make sure that the exposure regulator *2* (Fig.168a) does not rub against the disk *3*. The position of the bracket *4* can be adjusted because the screw holes in it are larger than the diameter of the screws.

In all camera systems and shutters, there is a part that shifts at a fixed angle or at a fixed distance for closing the contacts. In the "Zorki-C" design, the exposure disk *7* and the lever catch *1* (Fig.170) are used for this purpose. There is a post *6* (Fig.168a, b) on the exposure disk. When the shutter is released, the post shifts and touches the curve of the spiral contact positioned under the disk *3*. Since this contact is designed in such a way that it can turn along with the disk *3*, the timing of the post touching the contact curve can also be changed. This is how the contact timing controlled by the synchrocontroller is changed.

The interlocking contacts are closed by the lever catch (see p.114). At shutter release, the lever catch *1* (Fig.170) lowers and lets the contact *3* come down and close the contact with the contact *2*. (The contact pin *4* is resting against the lever catch.)

After the shutter is released, the lever catch *1* shifts upward and breaks the contact between the contacts *2* and *3*. Therefore, the electric circuit breaks, regardless of the fact that the post *6* (Fig.168a) stays in place and continues to touch the contact curve (until the next shutter winding).

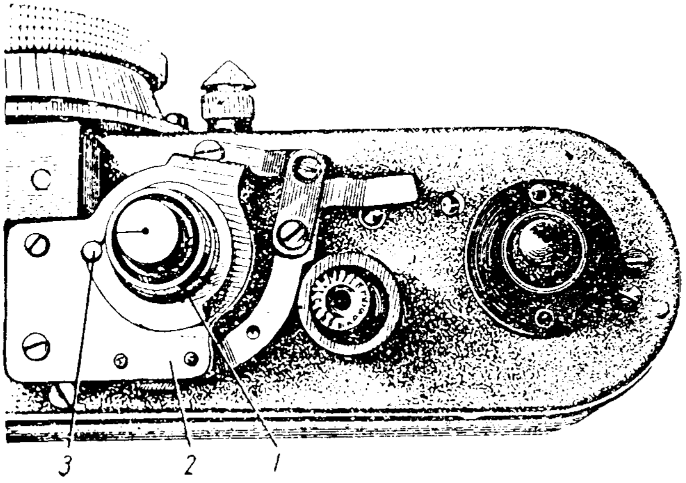


Figure 169. The synchrocontroller mechanism.

The interlocking contacts make the electric circuit close only at shutter release. At all other times while the flash is connected to the camera, the electric circuit is open. This is the operational principle of the contact mechanism and the synchrocontroller.

The flash socket *1* (Fig.166) is connected with the contact mechanism. When the top plate is placed on the camera, the pin of the flash socket contact on the top plate touches the contact.

Flash synchronization mechanism's malfunctions. 1. ***The flash socket is not secured.*** The flash socket *1* is inserted in the top plate *9* hole and fastened with a nut. If the nut gets unscrewed, the flash socket becomes rickety in the hole and can fall out, opening the electric circuit. To secure the flash socket, remove the top plate (see p.141). While you are reinstalling the top plate, start by lifting up the mechanism's contact. Since it is touched by the flash socket contact, this improves contact between the two of them.

2. ***The synchrocontroller zero position is displaced.*** When the flash is used, the shutter speed should be set at 1/25 sec, and the synchrocontroller handle has to be in the zero position. Sometimes, even when these rules are followed, part of the frame on the developed film is unexposed. This happens when the speed is set, for example, at 1/100 sec instead of 1/25 sec.

You should therefore always remember to check the speed before camera disassembly. The same problem may also occur when the synchrocontroller mechanism's handle *3* (Fig.167) fastened with a set screw is displaced. It usually means that the screw is loose.

To fix the problem, remove the top plate *9* (Fig.166) and observe the operation of the post *6* (Fig.168a). At the shutter release, the post is supposed to reach the edge of the contact curve. This is the zero position. If the post fails to reach the edge of the contact curve or goes too far, turn the traveling disk *3* manually until the contact is in the correct position.

Check whether the post *6* is secured well. Sometimes it is loose, and the flash synchronization mechanism either stops working all together or is displaced from its zero position. In that case, remove the contact mechanism, the exposure regulator *2*, and the exposure disk *7*. Having secured the post on the exposure disk, reassemble all the parts and mechanisms, and readjust the synchrocontroller zero position. Lastly, install the top plate *9* (Fig.166) and secure the synchrocontroller handle.

3. ***The flash socket malfunction is caused by a bad flash plug.*** The bad plug creates a loose fit in the flash socket interior insulated contact, and the flash synchronization mechanism stops functioning. To eliminate this defect, remove the plate *9* and check the flash socket.

4. ***Burned contacts.*** When pulsed flashes are used for a long time and, even more so, when this happens with disposable bulbs, the contacts get burned, building up a black coating. This results in breaks in the electric circuit. If this should occur, remove the plate *9*, check the condition of the contact springs and the post *6* (Fig.168a), and clean the burned areas.

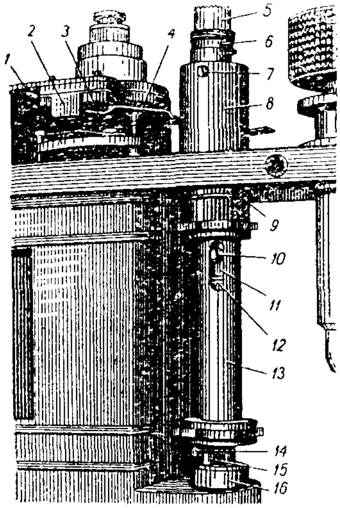


Figure 170. The transport sprocket disengagement mechanism.

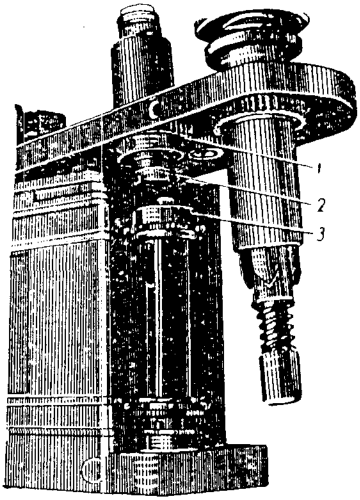


Figure 171. The transport sprocket coupling bushing.

Switch Mechanism of Film Rewind

The mechanism of disengaging the transport sprocket at the film rewind (see p.110) has changed the "Zorki-C" design as compared to the "Zorki" camera, but the mechanism's operational principle is the same. In the "Zorki-C" camera, the transport sprocket is disengaged from the winding and release gears by a special device (Fig.170, 171).

The Figure 170 shows the exterior view of the switch mechanism. Its major parts (two bushings with pins) are inside the transport sprocket *13*. The Figure shows part of the bottom bushing *11* with the screw *10* in its hole. The screw's head is in the longitudinal recess of the transport sprocket *13*, thus the bushing *11* can shift inside the transport sprocket within the shifting limits of the screw *10* head. The spiral spring *12* under the bushing *11* pushes the bushing and keeps it in the upper position. The top end of the lower bushing has two pins that enter the slots of the upper bushing connected with the winding mechanism.

The Figure 171 shows the mechanism with the lifted assembly plate and open top bushing *2*. The slots which are entered by the bottom bushing pins can be seen at the bushing end. The driving gear *1*, connected with the winding mechanism by means of other gears, moves the bushing *2* which drives the transport sprocket *13* by turning the bushing *11* (Fig.170).

The transport sprocket *13* advances the film and winds the focal plane shutter. The pin *14* is positioned in the bottom of the transport sprocket. A similar pin *15* is located on the gear *16* connected with the shutter mechanism. The transport sprocket advances the film and, simultaneously, winds the shutter.

During the film rewind, the transport sprocket *13* has to rotate in the opposite direction. For this purpose the bushing *11* has to be lowered in order to remove its pins from the bushing *2* (Fig.171). The gear *16* (Fig.170) should also be lowered so as to separate the pins *14* and *15*. Both steps are done simultaneously by turning the switch handle *4* (Fig.166).

The handle *4* is screwed to the tube *6* (Fig.170). The end of the screw *7* enters the oblique groove in the tube. The screw guides the movement of the bushing which lowers slightly when turned and transfers motion to the rod and the tube. The two latter parts separate the bushings and the pins, and unlink the transport sprocket. When the tube *6* turns, the bushing *11* and the gear *16* do down. At the pushing and turning of the knob *5*, the gear *16* lowers alone. This is the design and operation of the switch mechanism.

In addition to the major parts listed, the switch mechanism has a spiral spring under the knob *5* and a spiral spring under the tube *6*, placed inside the base *8*.

The transport sprocket in all cameras is fastened to the coupling *2* (Fig.171) with one or two shaped screws *3*. The screw end enters the groove in the coupling *2*.

Most later cameras were equipped with a switch mechanism of similar design. The difference is only in the camera disassembly order. You will find descriptions of various modifications in related parts of the book .

Mechanism disassembly. Mostly repair does not require complete switch mechanism disassembly and are done with partial camera disassembly when the mechanism is in the position shown in Figure 170. Complete disassembly cannot be avoided only in cases when the pins and coupling slots have been completely worn away.

To disassemble the upper part of the mechanism, unscrew the screw *7* (Fig.170). Since the springs can easily get lost during the unscrewing, hold the knob *5* and tube *6*. Disassemble the focal plane shutter in order to uncover the couplings and remove the transport sprocket *13*. The disassembly sequence of the focal plane shutter is described below.

Mechanism malfunctions. 1. ***The movement of the release button 5 (Fig.170) is obstructed.*** It happens when the spring under the button is displaced. Unscrew the screw *7*, remove the button, and check the spring.

2. ***The switch mechanism is in the "On" position, but during the shutter winding the transport sprocket 13 does not move.*** Check whether the screw *10* is in place for it often becomes loose and falls out. Also check the screw *3* (Fig.171).

3. ***During the shutter winding, the curtains snap off and return to their starting position.*** This malfunction is revealed in the loaded camera. It is caused by the worn away edges of the pins in the coupling *11* (Fig.170) or the slots in the coupling *2* (Fig.171). The brass coupling *2* slots are damaged most frequently. This malfunction is caused by excessive force used in film winding with defective cartridges. To fix the problem disassemble the shutter, unscrew the screw *3*, and remove the transport sprocket. It will uncover the coupling *2*. Correct the worn away corners of the slots with a thin file. To remove the coupling *11* (Fig.170), unscrew the screw *10*.

4. ***After the shutter release, the gear 16 (Fig.170) does not return to its place.*** This does not allow the shutter to continue winding, and the button *5* begins to shift too easily. The gear *16* is driven to the starting position by a flat spring. Sometimes, the spring cannot return the gear to its starting position due to a bent gear shaft or a displaced transport sprocket, and the pins *14* and *15* do not link during the winding of the shutter. Oil the parts inside the transport sprocket and strengthen the flat spring.

Complete Camera Disassembly

Complete camera disassembly includes the disassembly of the shutter and the shutter speed mechanism. All the shutter parts of "Zorki-C" and their sequence of disassembly are identical to those of the "Zorki" camera with the exception of the shutter body's fastening to the top assembly plate.

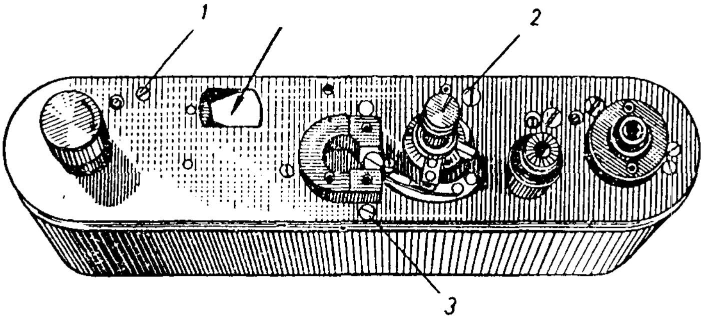


Figure 172. The top assembly panel.

Screws fastening the "Zorki" shutter body are put in from the side of the body. In "Zorki-C" these screws are put in from the side of the top assembly plate. (See the screws *1*, *2*, and *3* in Fig.172.) One of them is located under the rangefinder base. Consequently, the rangefinder also has to be removed during disassembly.

The camera is disassembled as follows. The shutter speed setting mechanism (see p.117) is disassembled first, then the rangefinder is removed (Fig.173). The rangefinder is fastened with three screws, one of which is located under the black washers of the film wind fork. The washers have holes for the screwdriver. Without removing them, turn the washers to position these holes over the screw heads. Note that the bushing of the "Zorki-C" rangefinder cam is fastened not to the assembly plate as in the "Zorki" camera, but to the rangefinder base. The bushing comprises a whole assembly shown in Figure 173. The bushing *1* is fastened with four screws. The lever *2* of the cam *3* is secured on the cam. The top assembly plate has a hole (see arrow in Fig.172) for installing the lever with the cam. The screws *1*, *2*, and *3* fasten the shutter body. Further disassembly and reassembly are the same as for the "Zorki" camera.

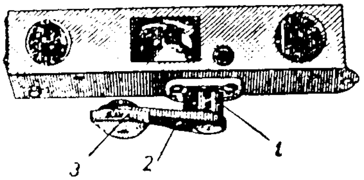


Figure 173. The rangefinder.

The winding mechanism is slightly different. It is far more reliable in operation due to the longer winding gear shaft which rotates inside the special tube. As a result, the winding gear cannot tilt or fall out during the removal of the winding knob because the end of the screw in tube is held by the beveled edge of the gear shaft. To remove the gear, untighten the screw.

"ZORKI-2C"

The "Zorki-2C" camera is an improved version of the "Zorki-C" camera. It is equipped with the selftimer and the "Industar-50" lens.

In earlier cameras (Fig.174), the selftimer mechanism design was the same as in the "Zorki-2" cameras (see p.140). But most of the "Zorki-2C" cameras have an improved selftimer mechanism included with all the later camera brands ("Zorki-4", "Zorki-6", FED-2, FED-3, "Zenit-3", "Crystal", "Start", etc.).

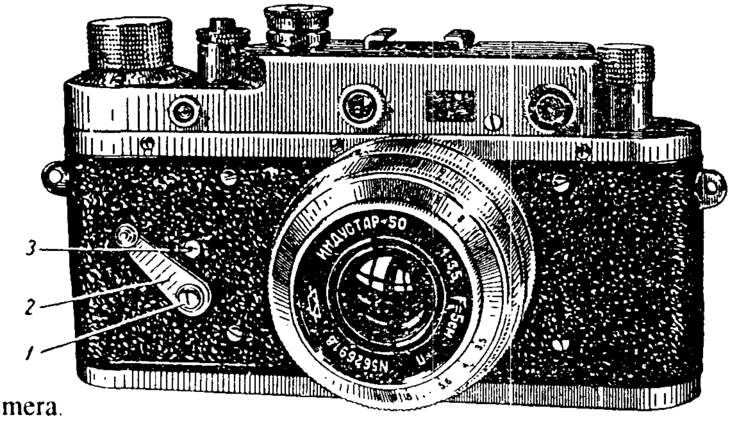


Figure 174. The "Zorki-2C" camera.

All the other "Zorki-2C" camera parts and mechanisms are identical to those in the "Zorki" and "Zorki-C" cameras. The following differences in the camera disassembly sequence are due only to the addition of the selftimer mechanism.

Camera Disassembly

For partial camera disassembly (see p.141), remove the selftimer winding lever *2* (Fig.174) that is fastened with the screw *1*. There is an adapter with pins under it which connects the lever with the selftimer shaft. The screw *1* goes through the hole in the adapter. Early "Zorki-2C" selftimers had the release button *3* (with an arrow on it) screwed in the hole *6* (see Fig.163) of the lever *7*; unscrew it gently with pliers during the disassembly. Do not unscrew the release button in the later camera modifications. (See the description of the selftimer design.)

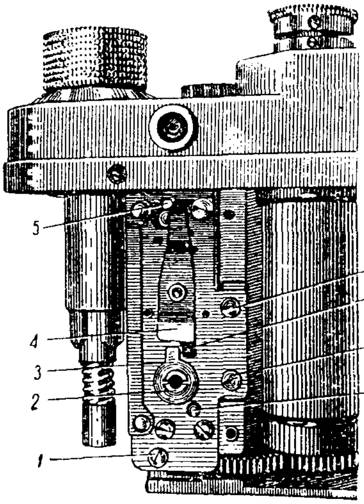


Figure 175. The focal plane shutter and the selftimer mechanism.

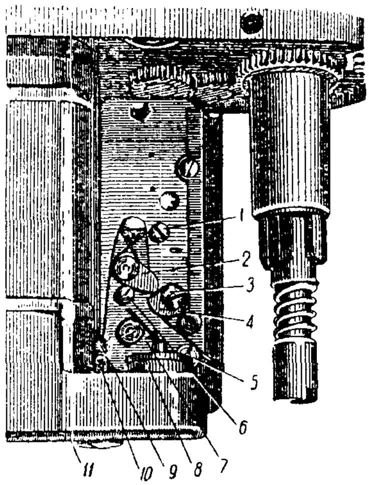


Figure 176. The selftimer adjustment.

Do not remove the selftimer mechanism even when disassembling the shutter completely because it is not involved in shutter disassembly and/or repair.

Selftimer

The selftimer mechanism (see p.22 on the delay mechanism) does an automatic shutter release 9-15 seconds after it was switched on.

Design and operational principle. The selftimer consists of the gear system and the pallet located between two plates and driven by the band spring inside the mechanism.

Figures 175 and 176 show the top and bottom views of the selftimer; Figure 177a, b shows its side views.

During the winding of the selftimer mechanism, only the gears *6* and *7* (Fig.177a) rotate. All the other gears, the escape wheel, and the pallet do not move. This is due to the fact that the top gear *6* shaft (see arrow) is installed not in the round hole of the top plate *4*, but in the longitudinal groove along which it can shift. During the winding of the mechanism, the gear *7* rotates clockwise and shifts the gear *6* and its shaft to the side. At this time the teeth of the gear *6* become unlinked with the teeth of the gear *9* (Fig.177b). When the selftimer starts working, the gear *7* (Fig.177a) rotates counter-clockwise and sets the gear *6* vertically. Due to this, the teeth of the gears become linked, and the gears and pallet snap into action.

The spring 2 is hooked to the gear *7* shaft and the post *1*. It is always in the wound position. The spring is half a turn short of full winding. The winding is completed during the winding of the selftimer.

The Figure 175 shows the positions of the levers *3* and *4* before the winding of the selftimer. The lever *3* is fitted on the shaft *2* and turns along with it. The lever *4* turns on the shaft, and its bending is located next to the arm of the pallet *5*. The lever *3* pin is positioned next to the lever *4* pin, and the lever *4* bending which rests against the pallet arm makes the selftimer operation impossible.

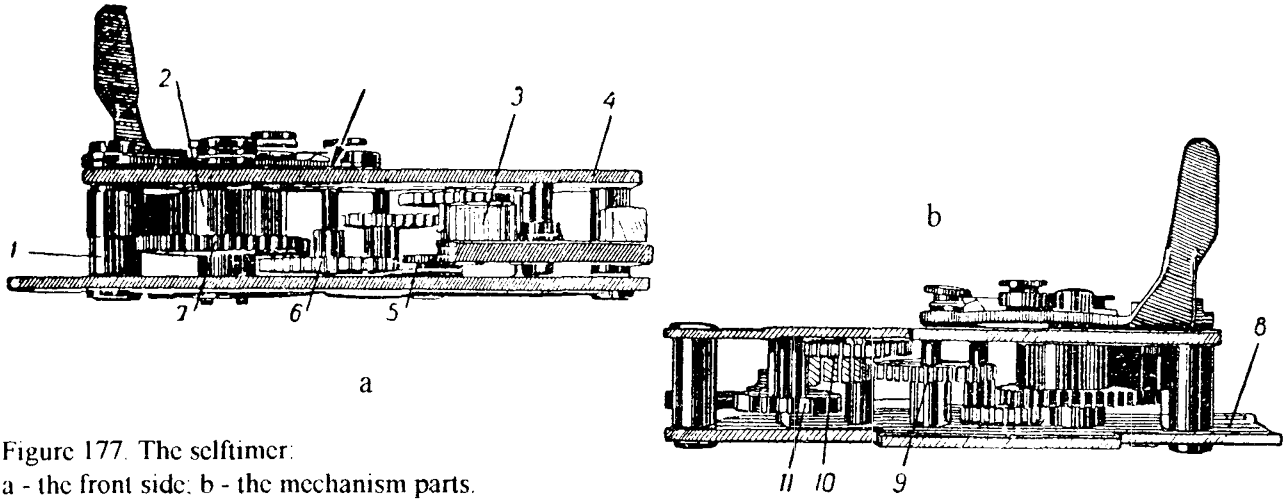


Figure 177. The selftimer:
a - the front side; b - the mechanism parts.

When the selftimer is being wound, the lever *3* makes a 180° turn and releases the lever *4*. But the lever *4* remains in its place, and its bending blocks the pallet arm. For the selftimer to start working, the lever *4* has to turn. This is accomplished by pushing the release button *3* (see Fig.256). Knobs of this type are installed in almost all contemporary cameras. The release button has a conical tip that is located next to the lever *4* (Fig.175). When the release button is pushed, the cone shifts the lever *4* aside and the selftimer starts working.

The selftimer is linked to the shutter and releases it with the aid of a special device (Fig.176).

The shutter is released by the lever *7* (Fig.176) or, to be precise, its bending *9*. Note the shape of the cam *4* on the gear *7* (Fig.177a) shaft. During the winding of the selftimer, the cam *4* (Fig.176) turns and stops in the wound position. The lever *7* does not move because the lath *2* turns freely and slides along the surface of the cam *4*. When the cam gets in the wound position, the lath *2*, driven by a spring, returns to the starting position.

The selftimer mechanism starts working after the release button is pushed. The cam *4* pushes the lath *2* again, this time from the other side. The lath now turns together with the lever *7*. When the lever *7* turns, its bending *9* hits the rod *10* located in the hole of the shutter body and resting against the release spring *11*. The spring *11* moves out, and the shutter is released.

Selftimer mechanism disassembly. Most of the selftimer malfunctions can be eliminated by its adjustment and do not require your taking the selftimer out of the camera. To remove the selftimer, partial or complete camera disassembly has to be done (depending on the camera design). The disassembly sequence is given along with each modification description. As a rule, the selftimer is fastened with three screws *1*, *6*, and *8* (Fig.175).

To disassemble the selftimer mechanism, unscrew the two screws in the plate *4* (Fig.177a) and remove the side plate; then unscrew the three screws in the plate *8* (Fig.177b) and remove the plate. Before removing the gears, memorize or sketch their positions.

Selftimer malfunctions. 1. ***The selftimer mechanism works, but the release spring 11 (Fig.176) does not move out, and the shutter is not released.*** This problem can have different causes. First, check whether the screw *5* that fastens the lever *7* is tightened. Second, wind the selftimer, push the release button, and observe the lever *7* and the cam *4* during the mechanism operation. Sometimes the bending *9* misses the end of the rod *10*. Incline the bending *9* slightly.

Apart from this, the screw *5* may loosen and allow the lever *7* to become displaced. Sometimes the lath *2* does not return to its starting position, and the cam *4* moves past it without turning it. Check whether the lath turns freely and the spring is in place. Sometimes the spring falls out of the slot in the lath *2*.

If all these parts are in place and functioning correctly, wind and release the selftimer mechanism again and check the transport sprocket as well as the release gear *8*. The spring *11* should push the gear *8* to connect the pins of the gear *8* (see arrow) and the transport sprocket. Otherwise, the shutter will not be released. If the pins will not separate, turn the cam screw *6* and lift the lath *2*. If this is not sufficient, unscrew the screw *5*; remove the lever *7* and incline its bending *9* slightly forward.

2. ***After the winding, the selftimer mechanism starts working arbitrarily before the release button is pushed.*** This malfunction is caused by the malfunction of the lever *4* (Fig.175). During the operation of the selftimer mechanism, the lever *4* is turned by the lever *3* and its bending stops the pallet *5*. The lever is supposed to remain in this position during the next mechanism winding, until the release button is pushed. This knob shifts the lever *4* away from the pallet. If the selftimer mechanism starts working arbitrarily, it means that the lever *4* and its bending are displaced.

There are several reasons for the malfunctioning of the lever *4*. The knob may be fitted too low, and then its cone is apt to jam the lever *4* (Fig.175). Unscrew the knob (its base has two slots) and check the selftimer operation without the knob. The mechanism can be released with any thin object by inserting it in the hole for the knob and moving the lever *4* aside. If the mechanism without the knob operates well, put the release button back in with one or two washers between the knob base and the camera body.

The lever *4* may not function if it is too loose or when pressed to the plate too hard with the rivet. If it is too loose, it shifts due to the slight shaking during the winding of the mechanism and releases the pallet. If it is pressed too hard, the lever *3* cannot turn it. To secure the lever *4*, remove the plate *8* (Fig.177b). It can be loosened without disassembly by gently lifting the lever's edge. If the pin *7* of the lever *4* (Fig.175) touching the lever *3* rubs against the body (the pin *7* is always bent upward), then the lever *3* cannot turn the lever *4*. Bend the pin slightly downward.

3. ***After winding the selftimer, the handle does not stay in the wound position.*** Sometimes, after the winding of the selftimer, the handle *2* immediately returns to its starting position, and the selftimer mechanism does not work. This is caused by serious defects in the mechanism gears: the gear *6* shaft (Fig.177a) is broken or the dial (a small-module cog-wheel with a small number of teeth) is loose on the shaft of this gear. The latter is more common. To secure the dial, put it on a hard surface and hit the puncheon placed on the gear side.

4. ***The wound selftimer mechanism does not work when the release button 3 (Fig.256) is pushed.*** This happens when the selftimer mechanism is clogged up or when the conical tip *c* (see Fig.258) of the release button does not move out of the lever *4* (Fig.175) sufficiently. In the former case, check and clean the selftimer mechanism, paying particular attention to the teeth of the gears. In the latter case, unscrew the base with the release button and check whether the selftimer mechanism operates when it is released with a foreign object placed in the hole for the knob. If the cause of the malfunction is the release button that is positioned too high, remove some of the body facing around the knob hole and set the knob lower.

5. ***The selftimer spring is broken.*** This problem is uncommon and is manifested when you cannot feel the force of the spring being overcome, and the selftimer does not function.

The broken spring can be shortened. Soften the spring end in the flame and make a loop for hooking it to the post *1* (Fig.177a). The spring should have a length that allows for half a turn until the completion of its winding, i.e., its full winding should be completed by the turn of the selftimer lever.

6. ***The selftimer lever movement is not restricted.*** This malfunction is fairly common. The selftimer lever should turn within 180^{o}. Sometimes during the winding of the mechanism, the lever turns more than 180^{o} or, more frequently, it makes a full turn when the selftimer comes into action.

The reason is that the turning of the lever *3* (Fig.175) is not restricted. Its movement should be restricted by the pin *7* and the brad *9*. The lever *3* is fitted on the shaft *2* and is not fastened with anything. When an adapter is put in (it is positioned under the selftimer lever), its pins press the lever *3* to the selftimer plate. If the lever is not pressed to the plate close enough and has a backlash, it may move over the brad *9* (Fig.175) or the pin *7* during the mechanism's operation.

The problem can be fixed without camera disassembly. In order to do it, remove the selftimer lever and the adapter, and make two adapter pins 0.10-0.15 mm longer by filing the adapter off around the pins. This defect can also be eliminated in another manner. In cameras where the body is easily removed (for example, "Zorki-2C", "Zorki-4", and "Mir"), remove and file the shaft *2* (Fig.175) bearing the lever *3*.

7. ***Release button malfunctions.*** The release button *a* (see Fig.258) consists of the base *b*, knob *c*, spiral spring *d*, and brass washer-holder *e*. The spring d is fitted on the shaft *c*, inserted in the base *a*, and fastened with the washer *e* in the knob *c* slot.

Sometimes the washer *e* falls out along with the knob *c*. Screw out the base and assemble the knob. If the washer *e* is inside the mechanism, find it because it may get stuck in the gears or in other parts of the camera and damage them.

If the knob moves with difficulty, oil it and check the spring *d*. If the base with the knob becomes loose, tighten it (the knob has special slots for it).

Selftimer operational tips. During the winding of the selftimer, turn the lever slowly, smoothly and, by all means, all the way. If the winding is done too quickly and jerkily, and the lever is let go immediately, the shaft or dial of the gear (see item 3) may break. During selftimer operation, do not stop the lever *2* or push it faster.

"Industar-50" Lens

Many contemporary cameras are equipped with this lens: "Zorki-2C", "Zorki-5", "Zorki-6", "Mir", "Zenit-C", "Zenit-3M", etc.

The "Industar-50" lens is an improved version of the "Industar-22" lens. It has better resolving power.

Specifications

Focal length	50 mm
Relative aperture	1:3.5
Field angle	45^{0}
Relative aperture range	3.5; 4; 5.6; 8; 11; 16
Distance scale range	from 1 m to ∞
Resolution in lines per 1 mm:	
in field center	38
on field edges	22

The "Industar-50" lens is manufactured in two mount designs: with the collapsible barrel and with the rigid barrel. The "Industar-50" with the collapsible barrel is the same as the "Industar-22" lens (see p.130). The design of the "Industar-50" lens mount with the rigid barrel is somewhat different. The mount consists of the diaphragm tang *4* (Fig.178), range scale ring *3*, depth of field scale ring *2*, and ring *1*. When the rings *3* and *1* (Fig.179) are removed, the multi-entry thread *6* and the rangefinding ring *5* can be seen.

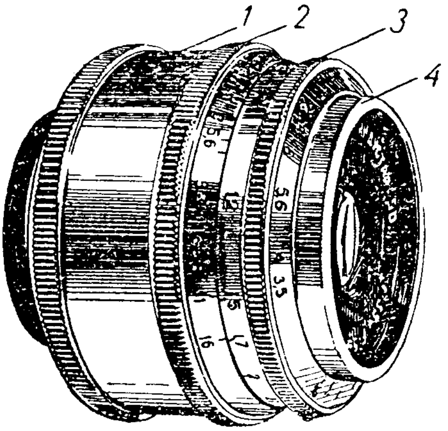


Figure 178. The "Industar-50" lens.

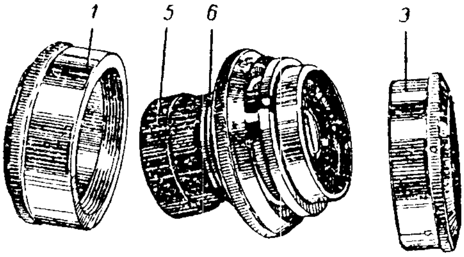


Figure 179. The "Industar-50" lens parts.

Lens disassembly and adjustment. The lens has a simple design and is easy to disassemble. To remove the ring *3*, unscrew the three set screws on it. The ring *1* is screwed on the thread. Before taking it out, however, you have to unscrew the set screw. When the rings *1* and *3* are removed, it becomes obvious how simple the lens mount is. The lens mount is also reliable in operation.

Many non-professional photographers purchase "Industar-50" and install it on older camera models (for example, FED and "Zorki") to replace non-functioning old lenses To install a new lens, adjust the lens with the camera and the rangefinder (for details on this see pp. 18 and 131).

If "Industar-50" is installed as a major and single lens (without interchangeable optics), the camera working distance should be set according to the lens working distance, after which the camera rangefinder is to be adjusted. If "Industar-50" is installed along with other optics, do not change the camera working distance. In that case, adjust the lens itself, i.e., adjust the lens working distance according to the camera working distance. This requires lens disassembly. In addition to the mount disassembly described above, unscrew the ring *5* (left hand thread); the ring *3* can be left in place. Then unscrew the ring on the back of the lens. This ring which holds the lens block has two set screws. Unscrew them and remove the ring.

The lens block is the same as in "Industar-10" (see p. 128), except for the shape of the diaphragm tang. The adjusting shims are located on the mount block. Adjusting of the lens working distance is done by choosing shims of appropriate thickness.

The rangefinder adjustment is described in detail on p. 135.

Studying the lens mount without the rings *1* and *5* (Fig. 179) reveals that what remains is nothing else but the "Industar-50" lens for the "Zenit" camera type.

Lens malfunctions. Some of the possible lens malfunctions are described on p. 129. Other malfunctions are listed below.

1. ***The ring 5 is loose.*** The rangefinder stops working, and there is a foreign object rattling inside the camera. Remove the lens, find the ring, take it out of the camera, and screw it back on.

2. ***The lens elements are not secured.*** After some time, the backlash of the lens mount rings *1* and *3* takes place. Tighten the set screws located in them.

3. ***The mount moves jerkily or with great difficulty.*** Oil the multi-entry thread. To do so, remove the ring *1* and lubricate the thread *6*.

"ZORKI-3", "ZORKI-3M", "ZORKI-3C", "ZORKI-4", AND "MIR" CAMERAS

Cameras of this group were designed along the same principle as the FED and "Zorki" cameras (see p. 105). A major feature of these cameras is the fast "Jupiter-8" lens (except for some modifications of the "Mir" camera) and the additional shutter speed mechanism. (1, 1/2, 1/5, 1/10 sec speeds in the "Zorki-3" cameras and 1, 1/2, 1/4, 1/8, 1/15 sec speeds in the "Zorki-4" cameras.) This broadens camera applications. The cameras also have a number of other design advantages, such as a removable back cover, 1/1000 sec speed, eyesight adjustment, a shock-absorber, an optical viewfinder and a rangefinder combined in a single frame, a two-cased split cartridge, etc.

The first in this group was the "Zorki-3" camera (see Fig. 180). Significant disadvantages of the camera were the two speed (basic and additional) setting knobs and the unreliable design of the additional shutter speed mechanism driven by a second curtain spring through a complex system of levers. The mechanism often malfunctioned.

The next version, the "Zorki-3M" camera, was free of this problem. The delay mechanism of additional speeds was totally changed and installed on the top assembly plate (see Fig.210). The speed knob controlled basic and additional speeds.

The new delay mechanism design proved its value, and all contemporary cameras with additional speeds ("Zorki-4", FED-3, "Leningrad", and "Start") are equipped with this mechanism.

The additional shutter speed mechanism of the "Droog" camera is basically the same, but arranged differently.

The "Zorki-3C" camera was equipped with a flash synchronization. Other parts were also improved: the rangefinder, the film winding mechanism, and the exposure counter. The need for rangefinder adjustment is much less common in the "Zorki-3C" camera than in earlier models; its accuracy is better. The flash synchronization mechanism installed under the top plate altered the shape of the camera.

Later "Zorki-3C" was equipped with a selftimer and renamed "Zorki-4".

The most common models in this camera group are "Zorki-3" and "Zorki-4", so their design and repair are discussed in detail.

Before studying the cameras of this group, it is recommended that you familiarize yourselves with earlier models of "Zorki" because the principle of operation and repair of these cameras is absolutely the same.

"ZORKI-3"

Major Exterior Camera Parts

The camera consists of the body *14*, exposure counter dial *1* (Fig.180), winding knob *2*, shutter release button *3*, release button rim *4*, switch mechanism handle *5*, shutter speed mechanism knob *6*, additional shutter speed mechanism knob *7*, optical wedge *8*, accessory shoe

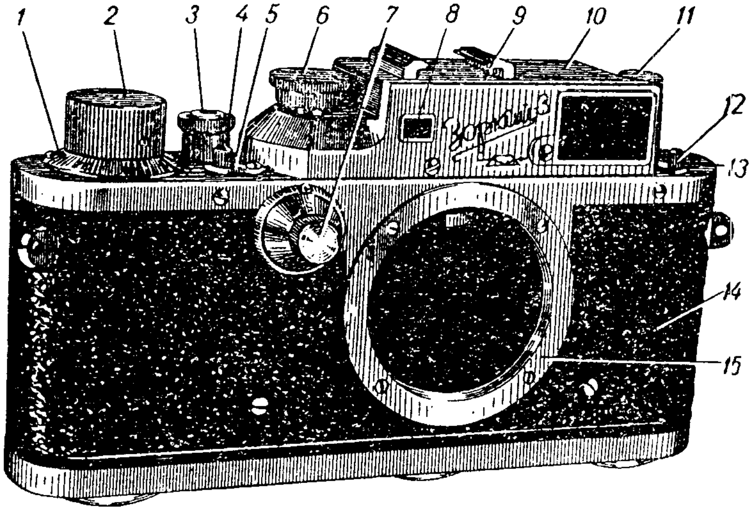


Figure 180. The "Zorki-3" camera.

9, top plate *10*, film wind mechanism knob *11*, dioptre sight correction handle *12*, top assembly plate *13*, and lens mount ring *15*.

Partial and Complete Disassembly and Reassembly

Most camera malfunctions can be eliminated with partial disassembly. Complete disassembly is done only for complicated repair of the focal plane shutter.

Partial disassembly is done in the following order: remove the top plate *10* and remove the mechanism from the body *14*. To remove the top plate *10*, unscrew four side screws and remove the shutter speed mechanism knob *6* with a set screw on it. To take the mechanism out of the body, remove the lens mount ring *15* (memorize the positions of the paper adjusting shims and keep these shims) and unscrew seven exterior facing screws (two on the body in front and five on the sides of the top assembly plate). When removing the lens mount ring *15*, memorize its position on the body. If it is reinstalled incorrectly, the lens will be installed improperly as well. (The diaphragm scale will be somewhere on the side or on the bottom.) An improperly installed lens mount ring is easily fixed by turning it 90° in either direction. To take the mechanism out of the body, apply some force or run a screwdriver between the surface where the lens mount ring *15* is screwed and the body itself where a cord-shim is glued in with shellac.

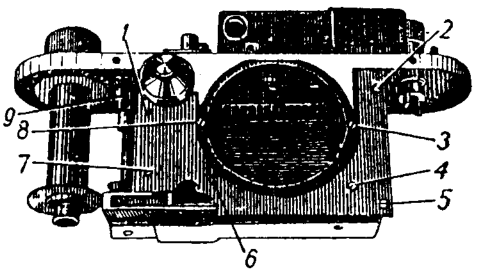


Figure 181. The shutter front plate.

After removing the shutter mechanism from the body, complete focal plane shutter disassembly is done in the following order. Unscrew the fastening screws and remove the plate (see Fig.181). Memorize the position of the screws because each may have a different size. The plate itself is fastened to the body with four long black screws *1*, *2*, *5*, and *7*. On the bottom of the plate there are protective shields of the bushing sleeves and of the curtain drum (see parts *1* and *5* respectively in Fig.184). To free the shields, unscrew the two short white screws *4* and *6* (see Fig.181), followed by the long black screws *3* and *8*. Remove the shields only after memorizing their positions. Now, unscrew the nut *1* (see Fig.185), remove the spring and the lever *2*, unscrew the screws *1* and *2* (see Fig.186) and remove the delay mechanism *4* (see Fig.184) secured on the bottom plane of the shutter body. The lower end of the rod *7* can now be removed from the socket, but do not take it out of the assembly plate. Also, do not take the levers off the rod. Further, you can disassemble the shutter speed mechanism: unscrew the screw and remove the exposure regulator *9* (Fig.185), unscrew the screw and remove the exposure disk *6*, remove the lever catch *8*.

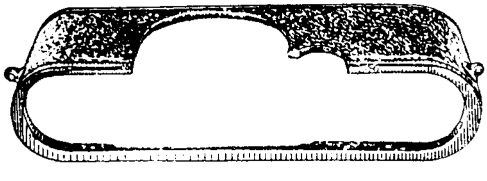


Figure 182. The camera body.

Whereas the "Zorki" camera has two shields *10* (see Fig.127), the "Zorki-3" camera has a frame *2* (see Fig.184) fastened with screws at the top and the bottom. While disassembling, free the shield at the bottom only by unscrewing the screws that hold the spring *6* (see Fig.186) and by removing the spring.

To separate the shutter body from the assembly plate, unscrew five screws: three on top of the assembly plate, two on the bottom of the shutter body lug where the film rewind fork *1* (see Fig.183) is located. The screws may be covered with a round washer. If it is not necessary to take out the drum with the pulleys, do not remove the shock-absorber cam *3* (see Fig.186).

Reassembly is done in the reverse order; but to reassemble and adjust the camera correctly, it is necessary to be familiar with the design of the focal plane shutter, additional shutter speed mechanism, rangefinder, etc.

Camera Body and Removable Cover

The body (Fig.182) and the cover are molded which warrants their durability. However as a result of strong impact, the body or the shutter plate (see Fig.181) bearing the lens may become deformed. In that case, remove them from the camera (see partial and complete disassembly), put them on a flat metal surface and straighten them with light strokes of a hammer. After the reassembly, camera and lens adjustment (see p.169) and rangefinder adjustment are necessary.

The removable cover almost never malfunctions. The locks are durable, and the pressure plate always has sufficient free movement that is necessary for the unhampered transportation of film.

Film Track

The camera film track is the same as in the "Zorki" camera. The film is pulled by the transport sprocket *4* (Fig.183), and the spool *5* on the friction clutch reels it. If the cartridge is good, the film in "Zorki-3" advances smoothly. The fork *1* is supposed to turn easily. Its shaft should be oiled frequently. Adjustment of the positions of the spool and friction clutch is done the same way as in the "Zorki" camera (see p.108).

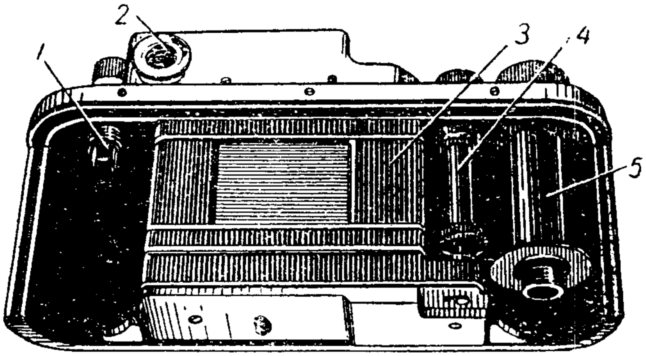


Figure 183. The film track.

Switch Mechanism for Film Rewind

The mechanism for disengaging the transport sprocket *4* (Fig.183) during the film rewind is somewhat different from that in the "Zorki" camera, but it is based on the same principle.

In the "Zorki-3" camera, the disengaging gear *9* (Fig.181) is disengaged from other gears in the mechanism by the cam that is turned by the handle *5* (see Fig.180). The gear *9* (Fig.181) does not have a pressing coupling, as opposed to the "Zorki" camera. The gear ledge supports an arm of the freely shifting plate fastened with two special screws to the shutter body.

There is a hole in the shutter body under the release spring *6* (see Fig.186). The rod in this hole rests against the plate arm with one end and against the release spring with the other end. Pay attention also to the hole in the spring *6* (see arrow). This is a hole for the release gear shaft with an undercut on the end. When the spring is moved out, the release gear shaft goes down along with it. Therefore, when the release gear *9* (Fig.181) goes down, the plate presses the rod which moves out the spring *6* (see Fig.186) along with the release gear. The pins of the sprocket and gear separate, and the sprocket is allowed to rotate freely.

Mechanism malfunctions. 1. ***The handle 5 (Fig.180) becomes loose, and the handle is displaced.*** In that case, gently put back the handle taking care not to knock the cam into the mechanism. First, put the handle on the cam in any position and then correct it. If the cam falls inside the camera, remove the mechanism from the body and reinstall the cam.

2. ***The gear 9 (see Fig.181) fails to push out the plate.*** Check whether the plate arm reaches the gear ledge. Make sure that one of the two guiding screws fastening the plate to the shutter body has not fallen out.

3. ***The plate moves out the release gear insufficiently, and the gear pin does not disengage from the transport sprocket pin.*** In this case, check to see whether the rod between the plate and the release spring is long enough and whether the plate is not deformed.

Focal Plane Shutter

The "Zorki-3" camera shutter is basically identical to the "Zorki" camera shutter. All shutter malfunctions (except for those of the additional shutter speed mechanism) are eliminated the same way as in the "Zorki" camera.

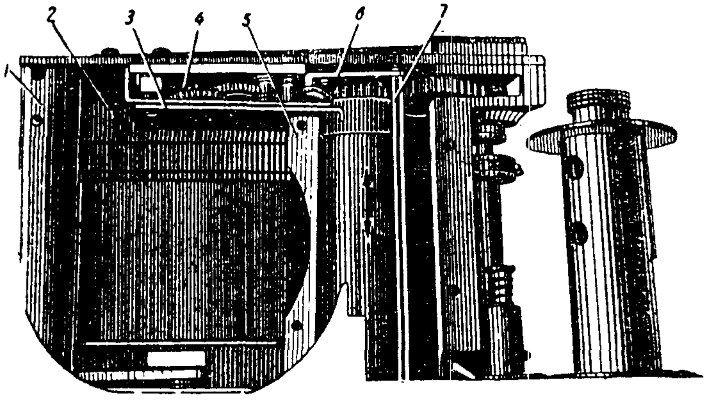


Figure 184. The focal plane shutter without the plate.

The following changes have been made in "Zorki-3" camera shutter mechanism. Speed 1/1000 sec was added. For that, one more hole was made in the exposure disk *6* (see Fig.185) and 1000 index was engraved on the shutter speed knob *6* (Fig.180).

The shape of the cam *7* (see Fig. 185) on the coupling square in the shutter mechanism was changed. A shoulder was made on the cam disk to switch to the additional shutter speed mechanism. Two shields *1* and *5* (see Fig. 184) covering the bushing sleeves and curtain drum have been added.

The shock absorber-cam *3* (Fig. 186) has been installed for absorbing the impact of the first curtain and protecting the camera from vibration during the operation.

Additional Shutter Speed Mechanism

The "Zorki-3" camera focal plane shutter mechanism is equipped with a new device - an additional shutter speed mechanism allowing shutter speeds of 1, 1/2, 1/5, 1/10 sec and long exposure time.

Mechanism operational principle. The delay mechanism *4* (Fig. 184) on the bottom panel of the shutter body is driven by the curtain mechanism through the moving rod *7*. The lever *6* is positioned on the lower part of the rod *7*, and the lever *4* (Fig. 185) is its the upper part. This system connects the shutter mechanism with the delay mechanism *4* (Fig. 184).

The rod *7* moves up and down (see arrow in Fig. 184). In addition its upper part can come down. There is an elongated groove in the assembly plate to allow the rod *7* go downward within its depth. This groove is covered by the lever *4* in Figure 185. Therefore, the lever *4* on the rod can move down toward the assembly plate and also toward the part *5*. This controls the exposure time. The lever *4* position depends on the positions of the spring *5* (Fig. 186) and the speed knob *1* (Fig. 187).

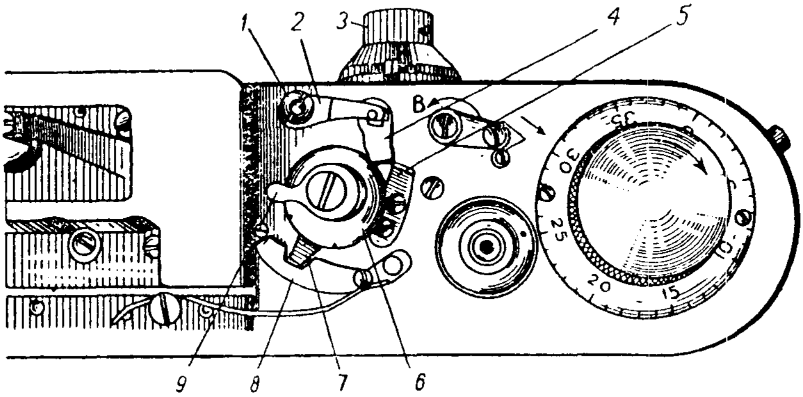


Figure 185. The shutter speed mechanism.

The flat spring *5* (Fig. 186) on the bottom of the shutter body lies parallel to the release spring *6*. Pay special attention to the part of the spring underneath the cam *3* where the spring's curved end is located. The spring itself does not lie on the shutter body, but is bent away from it. Only when the pin *4* reaches the spring branch piece, it is pressed to the shutter body and with that pushes the rod *7* (Fig. 184) up by approximately 1-1.5 mm. During the next shutter winding, the curtain drum begins to rotate along with the cam *3* (Fig. 186). The cam releases the spring *5*, it goes down and allows the rod *7* (Fig.184) to shift. The rod moves down driven by the wire spring under the lever *2* (Fig.185). The wire spring also presses the rod towards the knob *3*. Figure 186 shows the position of the cam *3* when the shutter is wound.

How does the curtain mechanism influence the additional shutter speed mechanism?

The cam *7* (Fig.185) is the part of a disk with a shoulder on its reverse side. This shoulder hits the lever *4* and turns it during the operation of the shutter(if long exposure time is set). The lever's motion is transferred through the rod *7* (Fig.184) to the lever 6 that turns the segment gear *11* (see Fig.190b) of the delay mechanism, and the mechanism starts working.

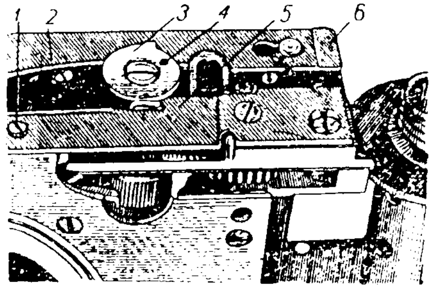


Figure 186. The bottom of the shutter body.

The moment the release button is pushed, the first curtain goes unhindered to the starting position, and the second one is detained because the lever *4* (Fig.185) delays the cam *7* which is connected to the second curtain through the coupling with the pin *1* (see Fig.135). After the delay mechanism has tripped, the lever *4* (Fig.185) turns, allowing the cam *7* and, therefore, the second curtain to move on. The lower the lever *4*, the longer the cam *7* shoulder touches it, and the longer the delay mechanism is involved in operation. This is how long exposure times work.

Let us discuss the operation of the shutter speed setting mechanism.

The additional shutter speed knob *1* (Fig.187) goes up or down during the setting of a certain speed. The cam *1* (see Fig.189) under the knob is located inside a hole in the panel. When the knob turns, the cam 1 goes up or down. The rod *7* (Fig.184) shifts along with the cam. The lower the speed knob, the longer are the delay mechanism's operation and exposure time.

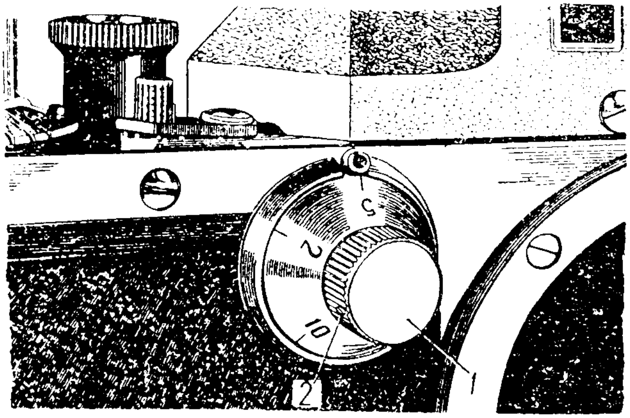


Figure 187. The additional speed knob.

In addition, the cam *1* (see Fig.189) touches the lever *2* with its bending which is hooked to the lath *2* bending (see Fig.190a) The lath is located on the delay mechanism and connected to the lever *14* (see Fig.190b) bearing the pallet *13*. The delay mechanism works with either a engaged or disengaged pallet (see details below) and is controlled by the same cam *1* (see Fig.189).

Mechanism malfunctions and their elimination. 1. ***The 1/5 sec speed does not work.*** The reason for this malfunction is that the cam *7* shoulder (Fig.185) does not hook the lever *4* during the shutter operation. When the speed is 1/5 sec, the time of these parts' contact is the shortest and requires great accuracy of their positions. To fix this problem, start by unscrewing

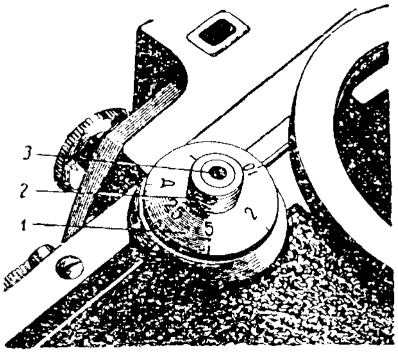


Figure 188. The additional shutter speed adjusting screw.

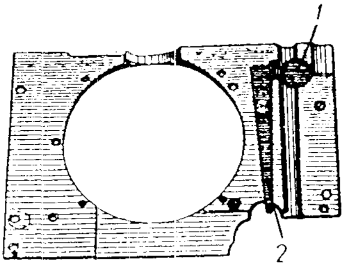


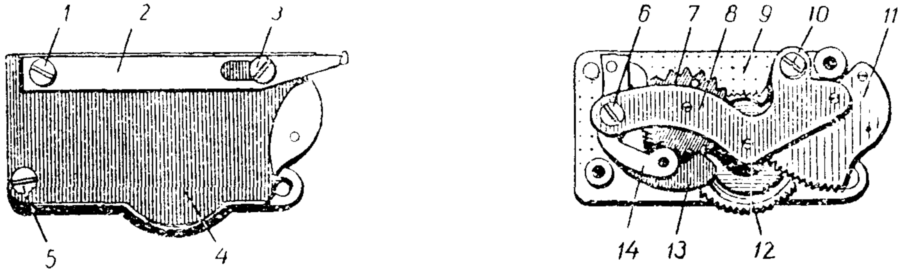
Figure 189. The interior side of the shutter plate.

the set screw *2* (Fig.187) of the top knob *1* and remove the knob. In doing this, you shall also remove the set screw *2* under the knob on the engraved disk *1* (Fig.188). You should now turn the screw *3* while holding the disk *1*. Rotate the screw *3* by turning it 1/2-1 times. This causes the cam *1* (Fig.189) to go down and the lever *4* (Fig.185) to set a little lower.

Having adjusted 1/5 sec speed, screw back the screw *2* (Fig.188) and put back the knob.

2. ***Additional exposure times are too long.*** All additional speeds are adjusted the same way as 1/5 sec speed.

If 1/5 sec speed is adjusted, all other speeds will mostly work well. Long additional exposure times may also be caused by the delay mechanism *4* (Fig.184) accumulating dirt over time. The delay mechanism disassembly and cleaning are described below.



a

b

Figure 190. The delay mechanism:
a - in casing; b - without casing.

3. ***The 1/10 sec speed does not function.*** The delay mechanism pallet works with all additional speeds. At 1/10 sec speed, the delay mechanism works without the pallet. The pallet *13* (Fig.190b) is turned off, and the gear and the escape wheel are idle.

The pallet is installed on the traveling lever *14* driven by the spring toward the mechanism escape wheel. If the lath *2* (Fig.190a) connected with the lever *14* (Fig.190b) is shifted, the pallet lever will shift and move the pallet, making it idle. The lath *2* (Fig.190a) is linked to the cam *1* (Fig.189) through the lever *2* on the back of the front panel. Thus, it is linked to the additional speed knob.

If the 1/10 sec speed does not work, check the system of the levers turning on the pallet *13* (Fig.190b). Pay particular attention to the gearing of the lath *2* (Fig.190a) and lever *2* bendings (Fig.189). The operation of the pallet and the levers can be observed without removing the front panel through a hole in the panel in the location of joined lath and lever bendings.

4. ***The additional shutter speeds do not work.*** Check the delay mechanism.

If the delay mechanism is dirty or if the spring that drives the segment gear *11* (Fig.190b) into the starting position has weakened, the mechanism stops working.

The delay mechanism consists of the segment gear *11*, gear *12*, escape wheel *7*, and pallet *13*. These parts are installed between two plates *8* and *9*. The mechanism has two springs: the first drives the segment gear *11* into the starting position, the second is connected with the lever *14*.

The lever *6* (see Fig.184) transfers the force of the second curtain's spring to the delay mechanism segment gear. The segment gear *11* (Fig.190) sets in motion all the mechanism's moving parts. The gear *12* consists of rollers clutch parts: the gear with the drum and the disk on the shaft. The disk covers the gear drum . There is a clutch with rollers on the other side of the disk inside the drum. This device allows the segment gear *11* to make a working stroke on its way in one direction and an idle run on its way back. The clutch teeth are shaped in such a way that when turned in one direction the rollers are pressed against the drum wall and the motion of the clutch connected to the disk is transferred to the gear. On the clutch' s way back, the rollers move away from the drum wall and the gear does not turn. This device is the most vulnerable in the entire delay mechanism.

If oil gets to the rollers, the mechanism stops working. The rollers stop functioning, and the delay mechanism is idle. For example 1 sec speed is set, but the actual speed is 1/10 sec (as with an idle pallet). You should then look for the problem in the indicated clutch.

To eliminate this defect, clean the mechanism. Start by removing the shutter mechanism from the body (see partial camera disassembly), then unscrew the screws *1* and *2* (see Fig.186) and take out the delay mechanism (Fig.190a).

The delay mechanism is disassembled in the following order. Unscrew the screws *5* and *3* and remove the washer located between the lath *2* and the casing *4*; unscrew the screw *1* and remove the lath *2*. There is a round brass bushing on the screw *1* between the lath *2* and the lever *14* (Fig.190b); remove that too. Then remove the casing *4* (Fig.190a) and clean the delay mechanism without further disassembly by immersing it in benzine and brushing it with a watch brush.

The delay mechanism's operation can be checked without installation in the camera. If the segment gear *11* (Fig.190b) is turned with an index finger without force, both the gear and the pallet should turn. When the segment gear comes to a halt, release it. Driven by the spring, it is supposed to return to its starting position quickly while the gear and the pallet must remain still. If the segment gear returns to its starting position slowly and the gear and pallet continue to rotate, the mechanism is malfunctioning. In that case, you shall have to disassemble the mechanism completely. Unscrew the screws *6* and *10* (Fig.190b) and remove the plate *8*; then remove the gear, the wheel, and the segment gear. Before disassembling, observe and memorize the position of the spiral spring on the segment gear *11* shaft. The gear *12* and the rollers clutch must be thoroughly cleaned in benzine.

Reassembly is done in the reverse order. Apply lubricant moderately on the shafts of the gear, wheel, and pallet. To assemble the gear and rollers easier, install the rollers first. Flip the shaft with the black disk and hold it in your left hand, hafting the gear with your right hand.

When installing the mechanism in the camera, check whether the lath *2* (Fig.190a) is set in its place, i.e., if the bendings of the lath *2* and the lever *2* (Fig.189) are in place.

5. ***Using the same shutter speed twice gives different exposure times.*** Let us consider a situation when the speed is set at 1 sec and then a second shot is taken with the same speed. It turns out that the second exposure time is less than the first one, which could be noticed by the sound. This malfunction is caused by the segment gear *11* (Fig.190b) that turns with difficulty and does not return to the starting position. To eliminate the problem strengthen the segment gear spring and clean the mechanism. Mechanism cleaning and disassembly are described in malfunction 4.

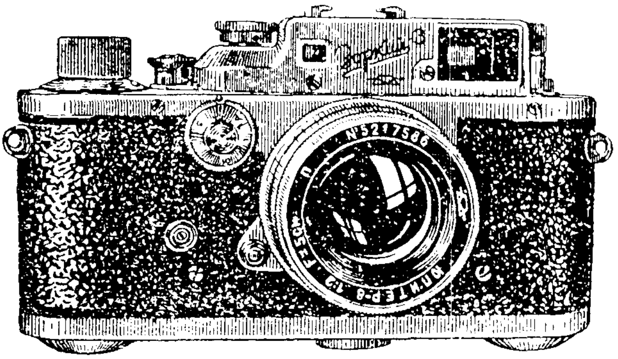


Figure 191. The flash socket on the body.

The mechanism can be adjusted with the cam screw positioned in front of the lever *14* of the pallet *13*. Turning the screw adjusts the contact between the pallet and the escape wheel.

Flash Synchronization Mechanism

The "Zorki-3" camera was manufactured without a flash synchronization. But a reliably operating flash synchronization can be made and installed on it.

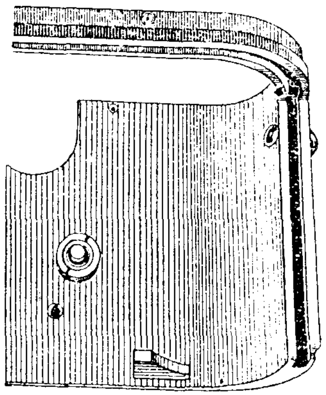


Figure 192. The flash socket installation.

The flash socket should be installed in the front part of the body (Fig.191). To install the flash socket, drill a hole with a 6 mm diameter drill. Before you start drilling, mark the shutter edge with a pencil and at a 3-3.5 mm distance make another mark with a pointed rod for the hole. Fasten the flash socket with a nut (Fig.192). You will find the details on manufacturing a flash socket on p.125.

Having installed the flash socket, start the contact mechanism installation. Use the flat spring *5* (see Fig.186) of the additional shutter speed mechanism for closing the contacts. This spring is pressed to the shutter body by the pin *4* during every operational cycle made by the shutter. Unscrew two screws and remove the spring *5*. Then file off the projecting plane of the shutter body (see arrow in Fig.193a).

This job should be done very gently and carefully to avoid scratching the finish on the shutter body. Drill two holes *1* and *2* with a 1.5 mm drill. Cut a M1.7x0.35 thread in the hole *1*. Make the hole *2* go through both shutter body planes and insert an electric cord in it. Next make and install a contact spring (Fig.194). The spring should be made of 0.005-0.10 mm thick brass. The spring's length must correspond to the size of that shutter body part where it will be installed.

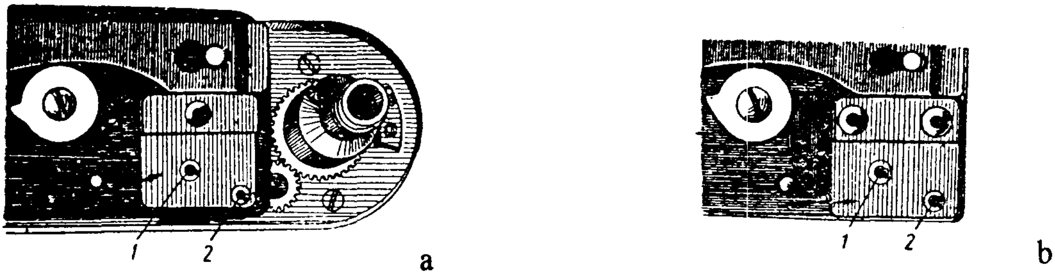


Figure 193. The contact mechanism's installation:
a - flat body; b - body with a shield.

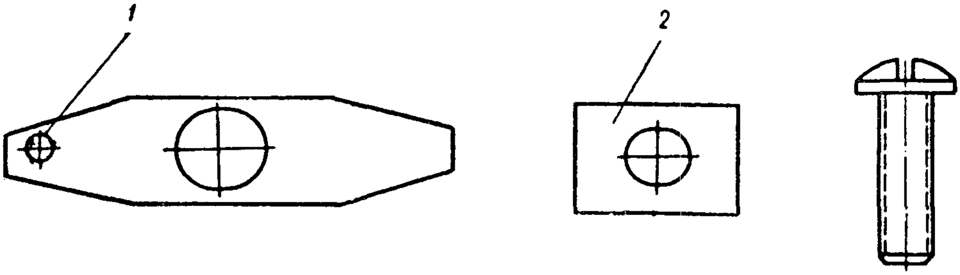


Figure 194. The contact mechanism's parts.

Drill two holes in the spring, 1.3 and 2.3 mm in diameter respectively. Insert the contact *1* (Fig.194) in the 1.3 mm hole and rivet it on the other side. The contact is made of silver or of brass if silver is not available.

Make two insulating washers *2* of 1 mm thick gitinax. Drill holes 1.8 mm in diameter in the washers. Put the spring between the washers *2* and fasten it with a M1.7x0.35 screw to the shutter body (Fig.195), so that it does not touch either the screw or the body.

Make two 1 mm holes with a puncheon in the flat spring *5* (Fig.186). Fasten a brass plate 0.2-0.3 mm thick to the spring (Fig.196) with two rivets. Next fold the prominent edge of the plate 5 mm long and 4 mm wide upward in the shape of a step. Finally, put the spring in place.

You can now reassemble the camera. Connect the flash socket to the contact mechanism with thin insulated wire running through the hole *2* (Figures 193 and 195).

The wire should be soldered to the end of the contact spring projecting from under the insulating washer. To make soldering the wire to the flash socket easier, remove the take-up spool drum and clean the soldered surface.

Viewfinder-Rangefinder

In the "Zorki-3" camera, the viewfinder is combined with the rangefinder in a single field of view.

The viewfinder-rangefinder consists of the following parts: the block of prisms glued together *3* (Fig. 197), prism lever *6* turning on shaft *7*, cam *5* with lever and cam *2* (Fig. 198) on its lower part, lens element secured on shield *4* and optical wedge *1*. (The shield is not present in Fig. 197 for better view of other rangefinder parts.)

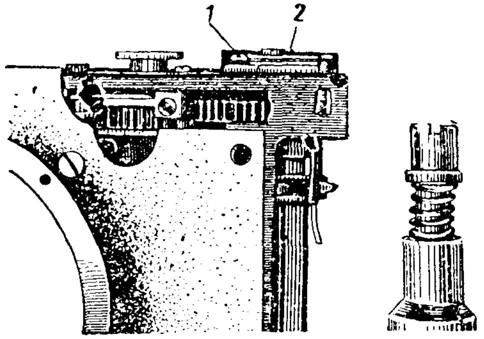


Figure 195. The shutter body with the contact mechanism.

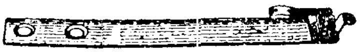


Figure 196. The spring with the contact.

The rangefinder operational principle is the same as in the "Zorki" camera (see p. 134). The prism block *3* (Fig. 197) consists of two prisms glued together. The joining surface has a beam-splitting layer which plays the same part as the mirror does in the "Zorki" camera. The prism block is fixed. A three-edged prism is glued to the lever *6* with shellac. This prism turns along with the lever.

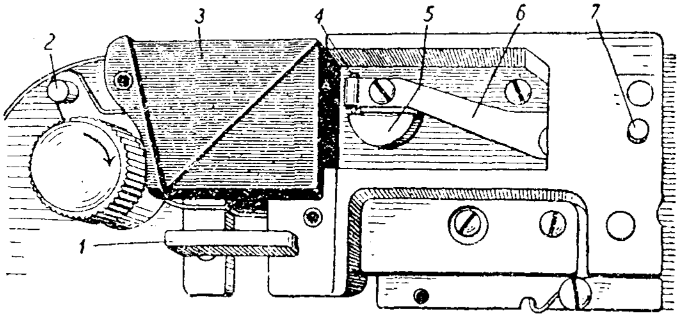


Figure 197. The rangefinder (top view).

The lens axial movement is transferred from the cam *2* (Fig. 198) to the cam *5* (Fig. 197) and the prism lever *6*.

Rangefinder adjustment. The vertical adjustment is done with the optical wedge *1* (Fig. 198). Unlike the "Zorki" camera where the optical wedge is positioned outside the camera, the "Zorki-3" camera's optical wedge is placed under the shield *10* (see Fig. 180). That is why its adjustment requires removal of the shield, i.e., partial camera disassembly (see p. 156). The optical wedge mount is glued with shellac. To turn it, lay a piece of moistened with alcohol cotton for 10-15 minutes on the mount and dissolve the glue. If the vertical adjustment cannot be achieved

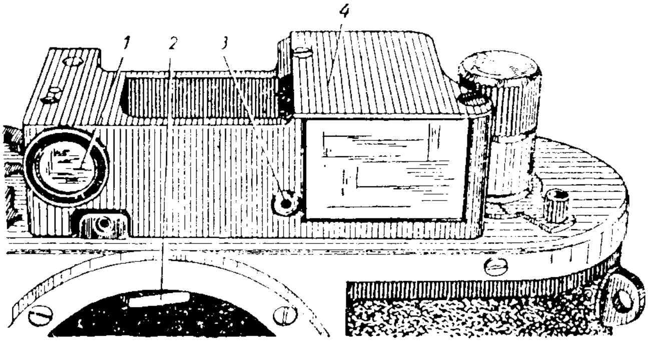


Figure 198. The rangefinder (front view).

with the help of the optical wedge, try to use the set-adjusting screws located on the side of the prism's lever *6* (Fig. 197).

The horizontal adjustment is done by the screw *4*. Do not remove the shield *10* (see Fig. 180) while working on the adjustment. Unscrew the screw on the shield, insert a thin screwdriver in the hole *3* (Fig. 198), and turn the screw *4* (Fig. 197).

Vertical and horizontal adjustments of the rangefinder are described in greater detail in the chapter on the "Zorki" camera.

Dioptre Sight Correction

Dioptre sight correction is done by the lens element *1* (Fig. 197) positioned on a movable mount. The mount itself is shifted by the handle *2* arm. The handle is secured on the bushing of the film rewind fork and fastened with a nut on its top.

Lens

Many camera models are equipped with the "Jupiter-8" lens. This explains why this lens is discussed in great detail. The "Jupiter-8" lens was first installed on the "Zorki-3" camera. A description will be given of the first lens model and all its later modifications.

The "Jupiter-8" lens (Fig. 199) is a complex fast anastigmatic consisting of six lens elements. Its middle component consists of three lens elements cemented together, and the rear component consists of two lens elements. The lens optics are coated. The lens diagram is shown in Figure 200.

Specifications

Focal length	52.4 mm
Relative aperture	1:2
Field angle	45^0
Relative aperture range	1:2; 1:2.8; 1:4; 1:5; 6; 1:8; 1:11; 1:16; 1:32
Distance scale range	from 1 m to ∞

Resolution in lines per 1 mm:

in field center	32
on field edges	16

Lens design and disassembly. The lens consists of a system of lens elements mounted along with the diaphragm, block (Fig.201), and exterior mount (Fig.202) for axial mount-block movement and for coupling the lens and the rangefinder.

In the first lenses the mount had a complicated design. It is not recommended that a non-professional disassemble the mount. The problem is that it is difficult to find correct thread entries during the reassembly. It is uncommon for the lens mounts to malfunction. When this does happen, they almost never require mount base disassembling.

In all the "Jupiter-8" lenses, the block is screwed on the thread. In the earlier models of lenses with mounts, the block is fixed with a set screw. To unscrew the block, unscrew the set screw first. This screw is located under the range scale ring *1* (Fig.199). The ring *1* is fastened with three set screws. Before taking off the ring, set the lens mount in a 1 m position. Having removed the ring, find the set screw which is not always visible (see arrow in Fig.203) because the thread and mount interior parts are covered with lubricant.

Once you have unscrewed the set screw, take the mount in your left hand and the diaphragm ring (tang) in your right hand and screw out the block. See to it that the adjusting rings *5* (Fig.201) do not fall out.

The mount design in later modifications of the "Jupiter-8" lens was somewhat simpler. The “Industar-26M" mount has a similar design. Its detailed description can be found on p.212.

Unlike the old design mount, the newer mount has screws *1* (Fig.264) on its reverse side. This mount is easy to disassemble and reassemble. All the old mounts and some later ones have a handle for turning them. The more modern "Jupiter-8" lens mounts do not have such a handle which was intended to increase the durability of the guiding threads.

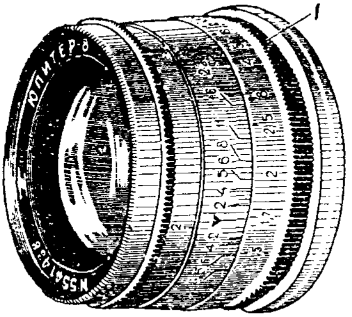


Figure 199. The "Jupiter-8" lens.

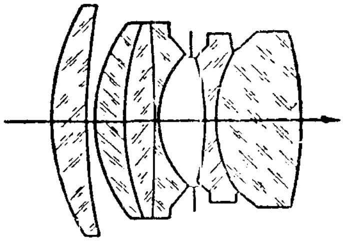


Figure 200. The "Jupiter-8" lens optical diagram.

In the lenses with a new mount, the lens block is not fastened with a set screw, but screwed in tightly. Unscrewing it requires some force. If the block does not come out, unscrew the lens back component. Its mount has two slots. (Do not confuse these slots with those on the lens elements' fastening ring located next to them.) When the back component is removed, the thread for the lens block can be seen. Apply watch oil moderately on the thread, and try unscrewing it again in a few hours.

When tightening the block during reassembly, turn it until the red dot on the depth of field scale stops opposite the index "2" on the diaphragm tang. If the adjustment rings *5* (Fig.201) had to be changed, you should tighten the block and correct the position of the diaphragm tang fastened with three set screws. It helps to make a hole under each screw with a thin drill. Then the ring (as well as all the other mount parts) will be secured better without deformation in the fastening areas. The mount parts will also be easier to turn.

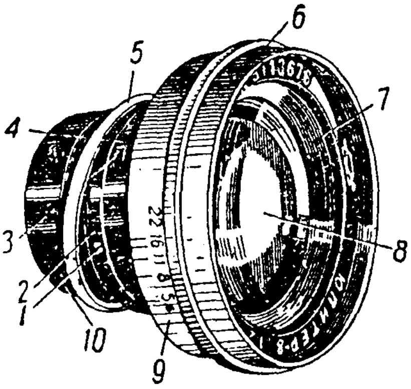


Figure 201. The lens block.

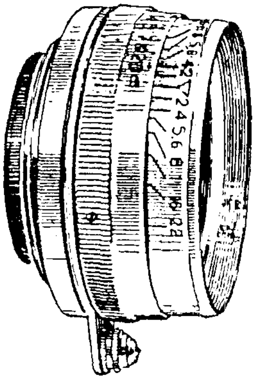


Figure 202. The exterior lens mount.

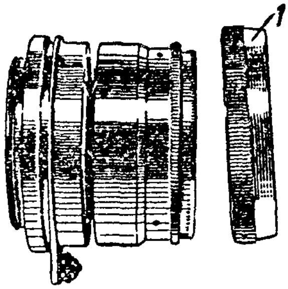


Figure 203. The parts of the lens mount.

You may displace he diaphragm tang while unscrewing the block. However, the tang is easily set in place after the mount reassembly and secured. as described above.

The block and diaphragm are disassembled in the following order. Unscrew the screw *1* (Fig.201) and the ring *2* and make marks on the ring and the mount to assist you during reassembly. Unscrew the screw *3* holding together the diaphragm ring and the diaphragm crown and remove the diaphragm ring *4* with the tang *9*. Then free the two set screws and unscrew the front lens mount ring *6*. Take out the bushing *7* and the front lens element *8*. Remove the bushing and the second, third, and fourth lens elements cemented together. Unscrew the mount *10* with the fifth and sixth lens elements cemented together. To remove the diaphragm blades, take out the crown fastening spring and the crown itself. The diaphragm reassembly is described on p.33. Set the crown so that the hole for screw *3* is positioned in the near end of the slot in the mount-block. This slot restricts the turning of the diaphragm.

Lens malfunctions. 1. ***Dirty lens.*** When cleaning the lens, it is almost always enough to unscrew just the mount 10 with the fifth and sixth lens elements. It is possible to unscrew the mount without disassembling the lens. This is done with a specially made key (see Fig.25) by inserting it in the slots on the mount. The lens cleaning is done as described on p.31.

2. ***The front lens mount ring 6 (see Fig.201) is not secured.*** The set screws loosen and the lens mount ring *6* slightly untightens because the filters are screwed on and off. If the lens

mount ring does not press the front lens element mount tightly, the lens element and the second component become loose. This results in decreased image sharpness. The problem can be detected by the looseness of the lens mount ring *6* and by the rattling sound produced by the lens elements.

To correct the problem, take the block out of the mount, partially disassemble it as described above, tighten up the lens mount ring *6*, and secure it with the set screws.

3. ***The mount 10 became loose.*** The mount *10* with the fifth and the sixth lens elements often becomes loose.

This malfunction causes decrease in the image sharpness. It can be eliminated without lens disassembly. The mount should be tightened with a key.

4. ***When the diaphragm 9 tang is turned, the diaphragm blades do not move.*** It happens when the connecting screw *3* becomes loose and falls out. Remove the lens block, find and install the fallen out screw.

5. ***The lens mount turns with great difficulty.*** This is a result of drying out or thickening of the lubricant. You must oil the rubbing surfaces and, especially, the multi-entry threads. If you have a camera with an old design mount, you should remove the ring *1* (Fig.203) from the mount and apply oil to the visible part of the multi-entry thread (see arrow). Do not forget to lubricate the guiding screw and the groove on the back of the mount. If your camera has a later design mount it should be disassembled and oiled (see p.214).

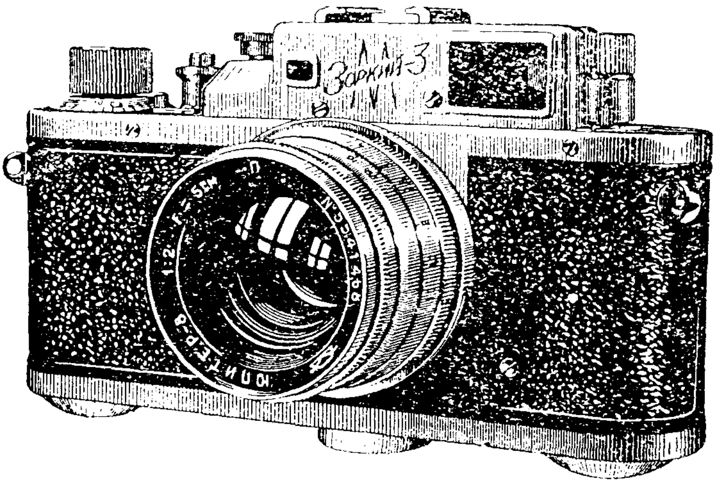


Figure 204. The "Zorki-3M" camera.

Some other lens malfunctions and their elimination are described on p.214.

Camera Adjustment

Camera adjustment consists in adjustment of the body and lens and adjustment of the rangefinder.

The body and lens adjustment principle is described on p.18. An explanation of its technique can be found on p.131. The adjustment is conducted the same way as in the FED and

"Zorki" cameras, but it can be accomplished without special tools, merely by using ground glass and a magnifier.

After this is done, you can adjust the rangefinder as described above.

"ZORKI-3M"

The "Zorki-3M" camera (Fig.204) is an improved modification of the "Zorki-3" camera. Specifications of both cameras are absolutely the same.

The "Zorki-3M" has an additional shutter speed mechanism with a different design than the "Zorki-3" camera's. The latter is identical to that of the "Zorki-4" camera mechanism described in detail on p.174. The "Zorki-3M" camera's switch mechanism for film rewinding has the same design as the one in the "Zorki" camera (see p.110).

All the other "Zorki-3M" assemblies, their malfunctions, and repair are the same as in the "Zorki-3" camera.

"ZORKI-3C"

The "Zorki-3C" camera (Fig.205) is an exact duplicate of the "Zorki-4" camera, except that it does not have an automatic shutter release mechanism (a selftimer). The "Zorki-4" camera is described in detail below.

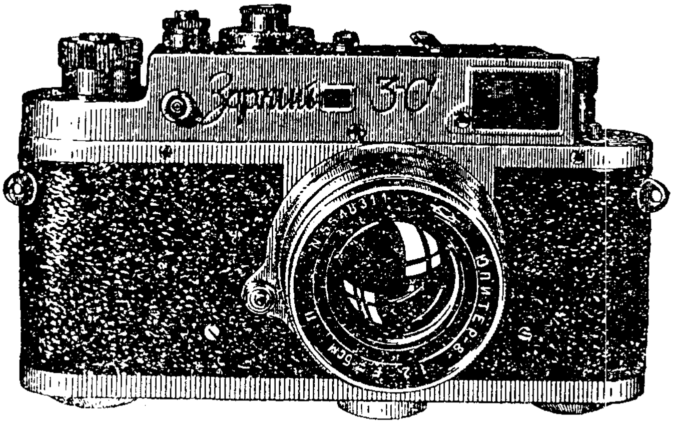


Figure 205. The "Zorki-3C" camera.

"ZORKI-4"

The best and most common model in this camera group is the "Zorki-4" camera (Fig.206).

Some of the "Zorki-4" mechanisms are identical to corresponding parts in cameras described above. For instance, the flash synchronization mechanism is the same as in the "Zorki-C" camera (see p.143). The dioptre sight correction mechanism is identical to the one in the"Zorki-3" camera (see p.166). The switch for the film rewinding is the same as in the "Zorki-C" (see p.145). The Zorki-4" camera winding mechanism is described on p.148. The film track and the film transport are described on p.157. To avoid repetition, the units listed above will not be described again.

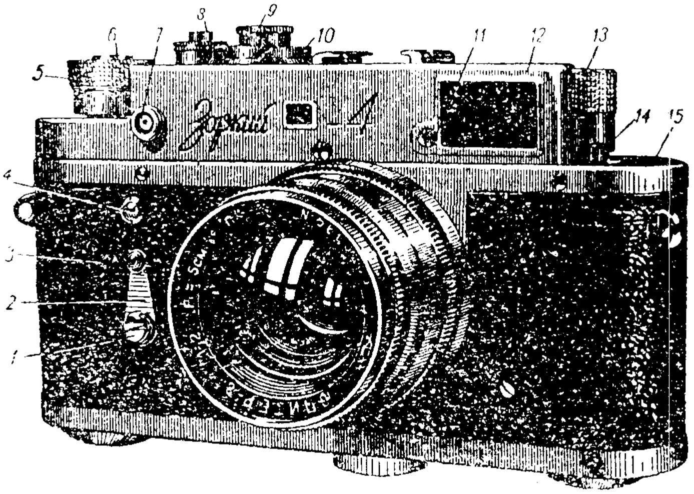


Figure 206. The "Zorki-4" camera.

Partial and Complete Camera Disassembly and Reassembly

Most repairs require only partial camera disassembly which entails the removal of the mechanism from the body *3* (Fig.206) and the removal of the top plate *12*.

To remove the top plate *12*, unscrew the exterior set screw on the knob *5* and remove the knob; unscrew the two screws located under the knob; unscrew the two set screws and remove the shutter speed knob *9*; unscrew the three screws on the sides of the plate (do not unscrew the screw 11); set the synchrocontroller tang *10* at the zero position, unscrew the exterior set screw on the tang, but do not take the tang off. Do not remove the knob *8* and its rim. It is then possible to remove the top plate *12* with the tang *10*. After that, put the knob *5* back because the shutter has to be wound and checked during repair.

To remove the mechanism from the body *3*, unscrew the screw *1* and remove the handle *2* with the adapter; unscrew two long screws on the front of the body and the five screws on the sides of the top assembly plate *15*. One of these screws is shorter than the others (memorize its position). Unscrew the four screws and remove the lens mounting ring. Almost always there are paper adjusting shims under the lens mounting ring so take the ring off with care so that the shims would not fall. Next remove the body. This is often a difficult task because of the glued-in cord-washer between the surface bearing the ring (see arrow in Fig.208) and the body. Put a screwdriver between this surface and the body and push it down.

The camera is completely disassembled in the following manner. The flash synchronization mechanism is fastened with the screws *1*, *2*, and *3* (Fig.207). The additional speed delay mechanism is fastened with two screws. Unscrew the screw *15* (see Fig.210), and then the screw

1 (see Fig.212) located under the gear *10* (see Fig.210). The order in which you remove and install the delay mechanism is given below on p. 177.

In order to access the bushing sleeves and the curtain drum, remove the shutter front plate *10* (Fig.208). To do that, unscrew the black long screws *4*, *5*, *8*, *9*, *12*, and *14* as well as the white short screws *11* and *13*; bend the rangefinder lever with the cam *7* inward, and remove the plate *10*. The shields *1* and *5* (see Fig.184) are positioned under the plate; they cover the bushing sleeves and the curtain drum. Memorize their positions and remove them.

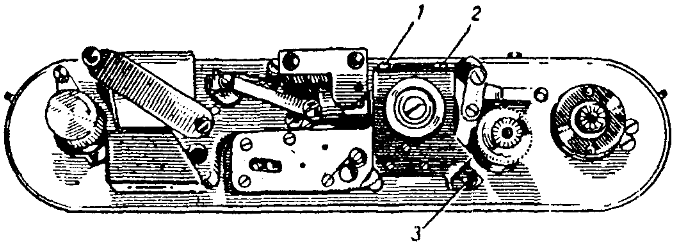


Figure 207. The top assembly plate.

To separate the body with the shutter from the top assembly plate, disassemble the shutter speed mechanism (see its design on p.114). Unscrew the screw *3* (see Fig.214a) and remove the exposure regulator *5* (there is a spiral spring under the screw); unscrew the screw and remove the exposure disk *4*; take out the lever- catch *8* whose shaft holds the black washer *7*; unscrew the screws *1* and *3* (Fig.209a). Remove the shield *2* carefully because there is a yellow cylindrical bushing under the screw *1* and a black cylindrical bushing and washer under the screw *3*; unscrew the screws *5* and *6* (Fig.209b) and remove the spring *8*. This will release the frame-shield *2* (see Fig.184).

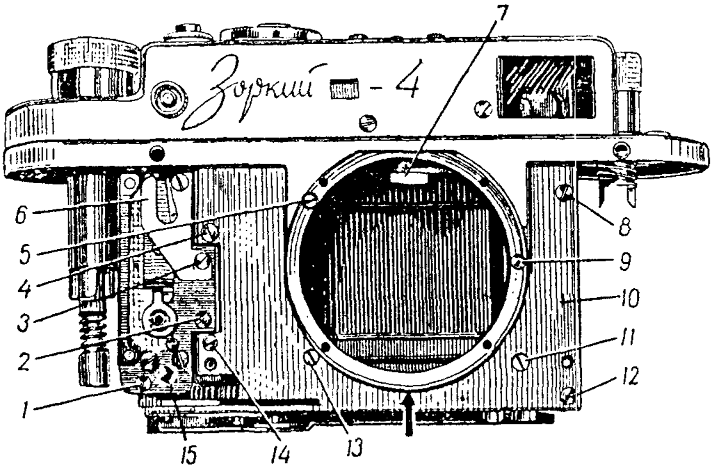


Figure 208. The shutter front plate and the selftimer.

The shutter body *12* (Fig.209b) is fastened to the top assembly plate with three screws; two of these screws are located under the washers *4* (their number varies), and the third is the screw *6* (see Fig.214a).

Do not remove the shock absorber cam *7* (Fig.209b) and/or disassemble the curtain mechanism gears unless it is absolutely unavoidable.

If the shutter has been completely disassembled, the reassembly requires proper installation of the gears *6* and *8* (see Fig.127 and p.117). In the "Zorki-4" camera, the winding of the curtain mechanism is not restricted by the gear *1* (see Fig.128), but by the gear *6* (see Fig.127) with a groove inside it; the length of the groove corresponds to the angular turn of the restricting gear 6 during the winding of the shutter. The groove contains the pin secured in the shutter body. This improvement significantly simplifies shutter reassembly because it does not require precise gear installation as in the FED camera.

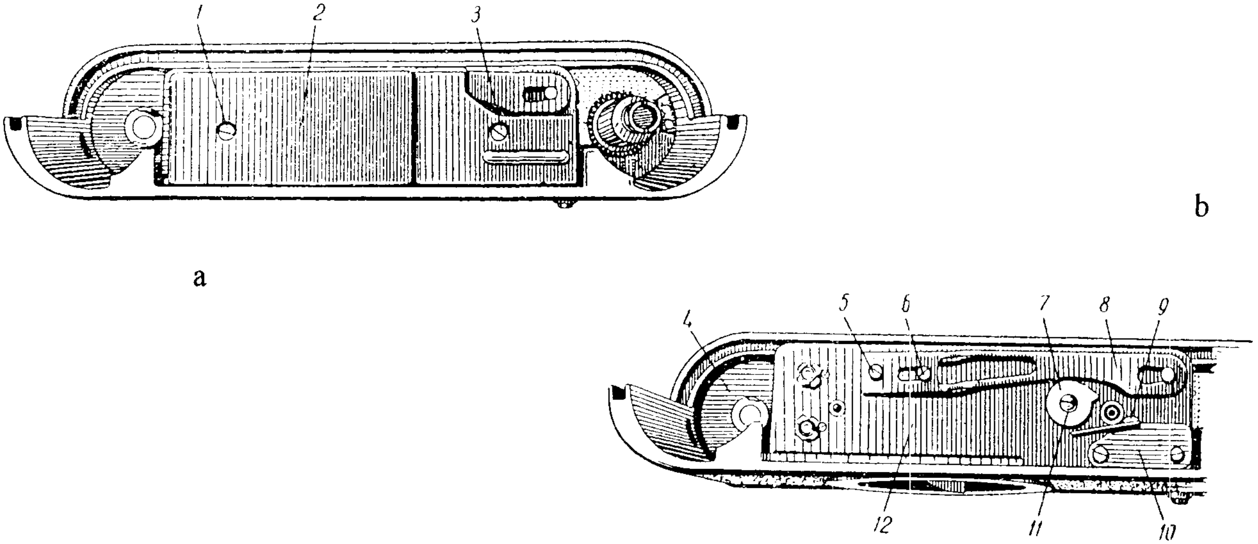


Figure 209. The bottom of the shutter body:
a - with the shield; b - without the shield.

To remove the rangefinder, unscrew the screws located under the washer *4* (Fig.209b); unscrew the screw located on the surface of the rangefinder (see Fig.214a) and the screw located in the hole in the delay mechanism base (see arrow). Do not remove the delay mechanism base *12* during shutter disassembly.

Focal Plane Shutter

The focal plane shutter of the "Zorki-4" camera is basically the same as the FED shutter. The only difference is in the sequence of its disassembly and reassembly. In addition, the "Zorki-4" camera shutter has a shock absorber for decreasing the impact of the first curtain and for protecting the camera from shocks that may occur during its operation.

The shock absorber consists of the spring *10* (Fig.209b) and the cam *7* secured with the screw *11* on the shaft of the curtain drum. When the first curtain returns to the starting position, the cam shoulder hits the spring shoulder and decreases the impact. Fig.209b shows the position of the cam in the wound shutter.

The spring *10* is fastened with two screws. It is not recommended to remove the accessory shoe because it does not affect disassembly and adjustment of other parts of the camera, and it also prevents the shaft *9* from falling out. To adjust the shock absorber, gently incline the spring bending of the spring *10* without removing it.

All malfunctions of the FED shutter may occur in "Zorki-4" as well, and the methods by which they are eliminated are fully applicable to the "Zorki-4" camera. However, the "Zorki-4" camera has some malfunctions peculiar to this particular modification - malfunctions of the selftimer setting and of the additional shutter speed mechanism. A description of these malfunctions is given below.

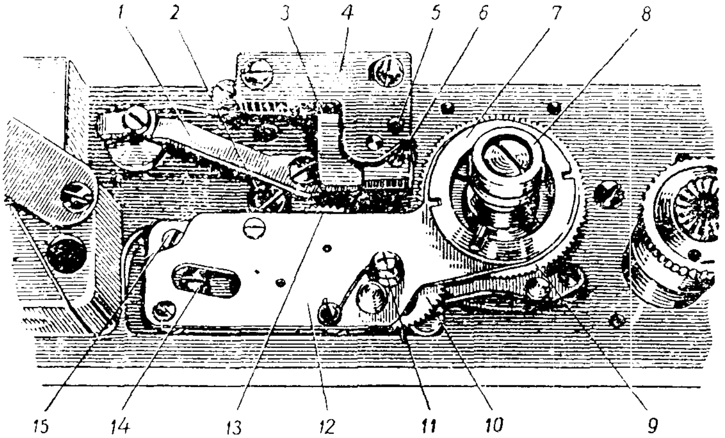


Figure 210. The delay mechanism and the top panel.

Additional Shutter Speed Mechanism

The additional shutter speed mechanism consists of the delay mechanism *12* (Fig.210) and the base *12* (Fig.214a). This mechanism is the most complex and the most vulnerable in the

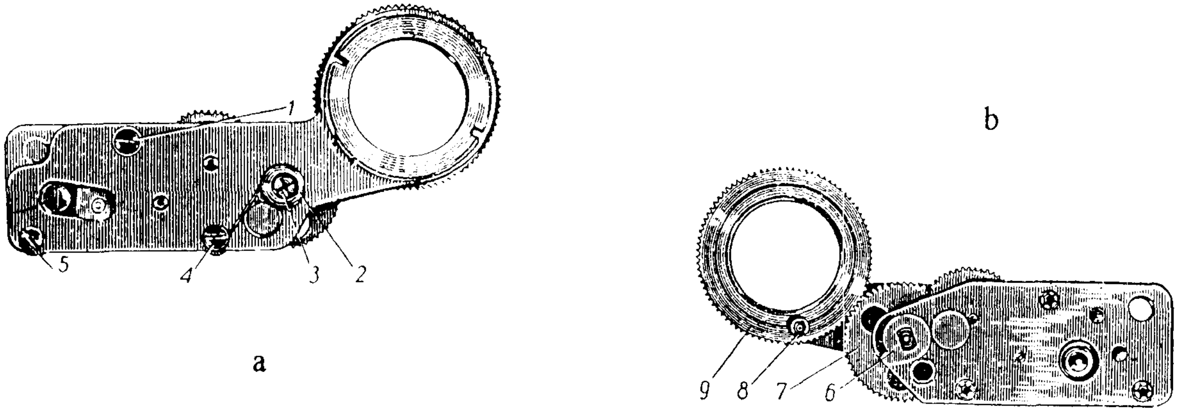


Figure 211. The delay mechanism:
a - view from above; b - view from below; c - the gear with the braking device drum; d - parts of the braking device.

"Zorki-4" camera. The operation of the focal plane shutter largely depends on the precision in the operation of the shutter speed mechanism.

Design and operational principle. The operational principle is the following. When the first curtain returns to its starting position and opens the frame window with the shutter functioning, the second curtain is detained by the mechanism's cutter. The delay mechanism (see p.22) is simultaneously involved in operation. The second curtain does not move during the operation of the delay mechanism (the time of its operation can be controlled), and it returns to the starting position after switching it off.

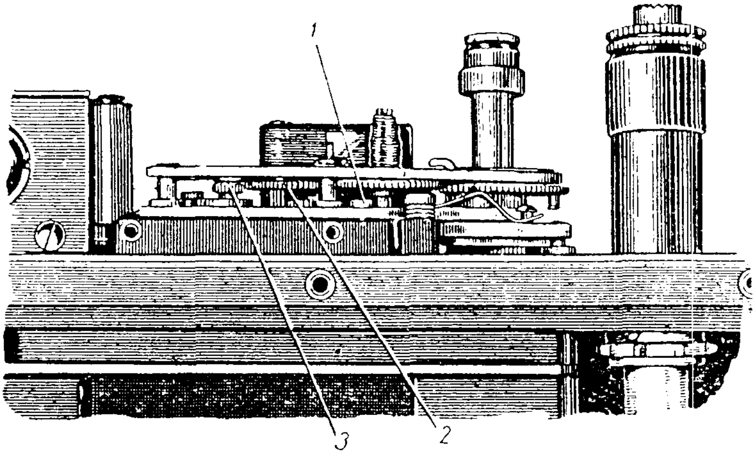


Figure 212. Parts of the delay mechanism.

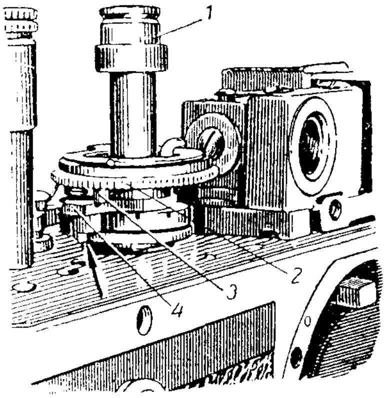
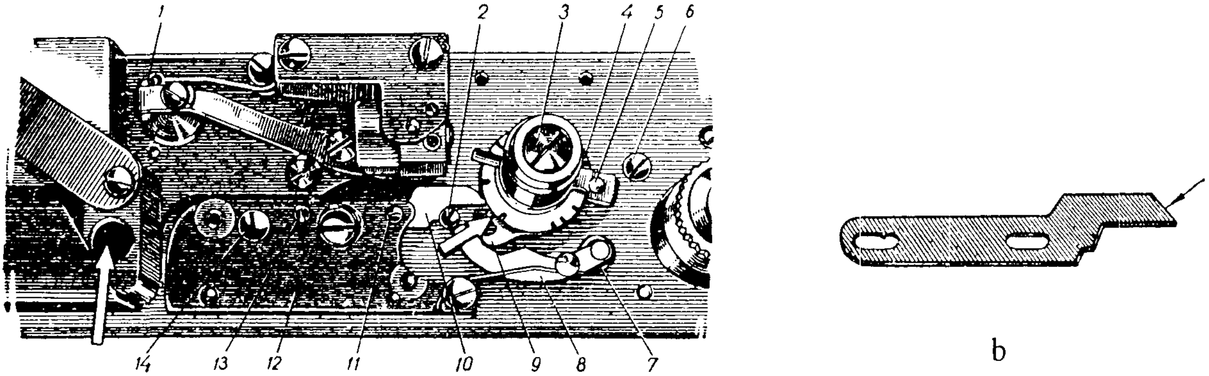


Figure 213. The positions of the time exposure regulator and the delay mechanism pin.

The delay mechanism (Fig.211a) consists of a system of gears and a pallet driven by the spring *2*. The spring is fastened on the shaft *3*, with the cam *6* (Fig.211b) positioned on the shaft's other end. The upper end of the spring is hooked to the shaft *3* (Fig.211a), and its lower end is fastened with the screw *4*. The spring is always wound.

The pallet *3* (Fig.212) is located on the lever which is fixed with the screw *14* (Fig.210). It is inadvisable to unscrew this screw. The pallet works with all the additional shutter speeds. The delay mechanism is fastened with two screws to the base *12* (Fig.214a) which is a plate with a hole for the slide-catch *10*. These parts form a very important mechanism whose disassembly is not recommended.

The slide-catch *10* is driven by a spring located under the base *12*. The spring directs its movement toward the shutter speed mechanism. The movement of the slide-catch is restricted by the screw *2*. The Figure 214b shows the configuration of the slide-catch. In it, you can see two longitudinal grooves containing the screws *11* and *13* (Fig.214a). They allow the slide-catch to move only in one direction. The tip of the slide-catch has a tilted surface on top (see arrow in Fig.214b) and a flat surface on the bottom.



a

b

Figure 214. The delay mechanism base:
a - the base plate; b - the slide-catch.

All the functions of the additional shutter speed mechanism are controlled by the basic shutter speed mechanism.

The pin *8* (Fig.211b) is on the lower plane of the gear *9*. When the speed knob *9* (Fig.206) is lifted and turned at 1 sec speed, the exposure regulator *1* (Fig.213) bearing the knob catches the pin *3* with its arm *4* and turns the gear *2*. At this time, the gear *7* (Fig.211b), the shaft with the cam *6*, and the winding spring *2* (Fig.211a) begin to rotate. All the other gears and the pallet remain still.

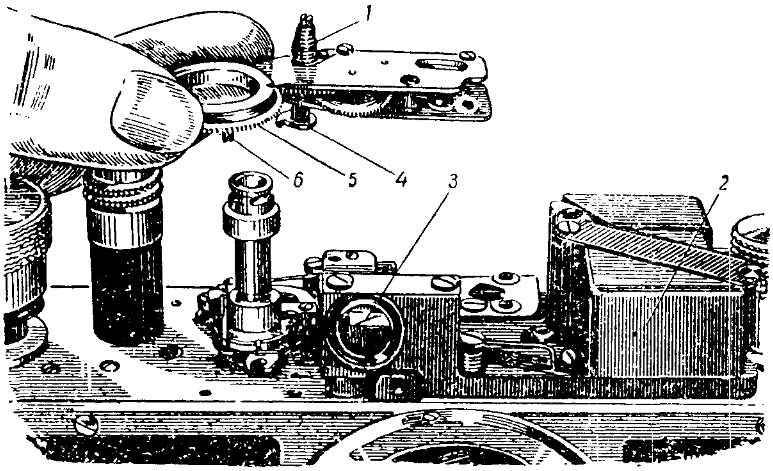


Figure 215. The installation of the delay mechanism.

The number of grooves in the time exposure disk *4* (Fig.214a) corresponds to the number of shutter speeds. Some grooves are milled through and some are not. The exposure regulator has a rectangular tip (see arrow in Fig.213). Depending on the set shutter speed, this tip gets into a certain groove on the disk. If the groove goes through to the other side, the exposure regulator will be set low, and if the groove does not, the regulator will be set higher.

Grooves that do not go all the way through the exposure disk correspond to the additional shutter speeds. For instance, when the speed knob is set to 1 sec, the exposure regulator catches the pin *3* (Fig.213) and turns the gear *2*, i.e., winds the delay mechanism. Thus after the 1 sec speed is set, the exposure regulator holds the pin *3* and the delay mechanism in the wound state. The exposure regulator is fitted in a groove that does not go through the exposure disk, i.e., it is higher than at regular speeds. If the exposure regulator is set in a hole that goes through the disk, its arm *4* will be lower than the pin (as shown in Fig.213) and will not catch it.

There is one part of the shutter speed mechanism that is very important. The cam *9* located under the exposure disk *4* (Fig.214a) gets into the slot on the lever catch *8* and detains the second curtain for some time. In doing this, it creates a certain shutter speed (see details on p.114). This cam has a bending (see arrow). When the shutter is being wound (it is wound until the desired speed is set), the cam's shoulder runs by the slide-catch *10*, gets on its angled surface (see arrow in Fig.214b), moves the lever out in a perpendicular direction, and stops above the slide-catch (as shown in Fig.214a). Then the slide-catch, driven by a spring, returns to the starting position. When the shutter trips, the cam's shoulder does not get on the angled surface of the slide-catch, but on the flat plane, and it then stops (along with the second curtain) until the cam *4* (Fig.215) moves the slide-catch aside.

The slide-catch is always in the way of the delay mechanism's cam shoulder. How do all the other shutter speeds work then? The spring *11* (Fig.210) is always wound and winds even more during the winding of the delay mechanism. When the delay mechanism is not wound, the cam *4* (Fig.215), driven by the spring *1* pushes the shoulder of the slide-catch *10* aside (Fig.214a). This spring is stronger than that of the slide-catch. Therefore, the slide-catch does not block the cam at all basic shutter speeds. One of the reasons for shutter malfunction (see details below) is that the cam has no impact on the shoulder of slide-catch. It causes a blocking of the second shutter curtain. For the same reason, the shutter will not work if the delay mechanism is removed. Bear this in mind during disassembly.

One of the features of the delay mechanism is its ability to make a working cycle as well as an idle one. When the mechanism is being wound, only the gears *9* and *10* rotate; the other gears and the pallet remain still - an idle cycle occurs. When the mechanism trips, all the gears and the pallet rotate - the working cycle occurs. The functioning of such a mechanism is due to the clutch device located inside the gear (see Fig.80d). The device consists of a special cam and four cylindrical rollers. When the cam turns in one direction, the rollers move and stay off the drum wall. When the cam turns in the other direction, the rollers get pressed against the drum wall and rotate the gear. This clutch device must not be oiled.

Mechanism disassembly and reassembly. All the repairs of the "Zorki-4" camera that do not require the removal of the delay mechanism are simple. Removing the delay mechanism and reinstalling it presents a certain difficulty. It can be correctly reinstalled in the camera only by a person who understands its operational principle.

To remove the delay mechanism, unscrew the screw *15* (Fig.210) and the screw *1* (Fig.212) located under the gear *10* (Fig.210). The gear *10* has holes for a screwdriver. You should turn the gear with your finger until the hole in the gear coincides with the screw's head. If the mechanism is dirty or the camera has been immersed in water, the gear does not turn. In this case, tilt the camera (as shown in Fig.212) and unscrew the screw using a screwdriver.

Remove the delay mechanism slowly, and hold the gear *5* (see Fig.215) with two fingers of your right hand to prevent rotation. Having removed the mechanism, observe and memorize the positions of the pin *6* and the shoulder of the cam *4*. You should remember that the operation of the delay mechanism and that of the focal plane shutter depends on the correct positioning of these parts. Presently, release the gear *5* and count the number of turns it takes for the spring *1* to unwind completely. This is done to simplify the reinstallation of the mechanism parts.

To reinstall the mechanism correctly, wind the gear *5* turning it the necessary number of times, and put the mechanism back while holding it with two fingers of your right hand. The shoulder of the cam *4* should be positioned in front of the shoulder of the slide-catch *10* (Fig.214a). Then take the gears and the pallet of the mechanism with your left hand, turning the gear *9* (Fig.210) a little with your right hand until one of the holes on the gear *10* coincides with the head of the screw *1* (Fig.212). Tighten this screw, and the screw *15* (Fig. 210). The diameter of the holes for the screws is larger than the diameter of the screws to allow the delay mechanism to shift slightly while its interaction with other mechanisms is being adjusted.

After the mechanism is installed, wind the gear *9* by hand, release it, and check whether the gears of the delay mechanism rotate freely and the shoulder of the cam hits the slide-catch shoulder. When this happens, the slide-catch is supposed to shift out.

This is how the proper position of the pin *3* (Fig.213) is verified. When the shutter is wound, the pin should be somewhere between the holes for 1/60 and 1/15 sec speeds on the exposure disk as shown in Figure 213. If the pin is not in place, loosen the nut *7* (Fig.210) with a special key (see Fig.25), turning it 1.5-2 times. Slightly lower the gear *9* to disengage it from the gear *10*, turn it, correct the pin's position, and tighten the nut.

The delay mechanism should be positioned in a way that allows the exposure regulator *8* to be set in the center of the fastening nut *7* of the delay mechanism.

The base *12* (Fig.214a) is fastened with three screws: two are located on the bottom of the assembly plate and one (screw *14*) is on the top. The screws should be tightened to keep the base in place. If the base has to be removed, remember about the thin V-shaped spring which is located under the base. One end of this spring rests against the base wall, and the other end rests against the slot in the slide-catch *10*.

If needed, disassemble the delay mechanism as follows. Unscrew the screws *1*, *4*, and *5* (Fig.211a), lift the plate, and remove the gears. Observe the gears before disassembly and memorize their positions.

Mechanism malfunctions. 1 ***The speed knob turns are restricted, and the shutter does not work.*** This is one of the most common malfunctions. It usually comes up suddenly while you are shooting, although the shutter may have worked well before that.

"The exposure lever has jumped over" - this is the way that camera repairmen describe this problem. Indeed, it occurs when the exposure lever *4* arm (Fig.213) gets on the other side of the pin *3*. In this position its turning is restricted by the post that closes the flash synchronization circuit on one side and by the pin on the other side. It is impossible to set the "B" speed, and the curtains shift a little and stop if the shutter release button is pushed.

This problem is most often caused by two factors: first, the speed knob was set before the winding of the shutter; second, the pin *3* or the delay mechanism was displaced and as a result, the lever jumped over the pin *3* during the shifting of the speed knob from 1/60 sec to 1/15 sec. When the speed knob is lifted, the exposure lever that bears it is lifted too. Its arm along with the pin is next to the pin *3* (Fig.213). Right away, the lever arm catches the pin *3* and turns along with the gear *2*. Sometimes the pin shifts slightly (due to looseness or a displacement of the mechanism). Then the exposure lever arm does not set next to the pin during the switching to 1/15 sec speed, but instead, sets right on the pin, and at the next turn of the lever, it jumps over without catching the pin. Usually this problem is easy to correct. Remove the top plate *12* (Fig.206), examine the mechanism and gently lift the edge of the plate with the gear *2* (Fig.213). You should now reset the exposure lever. Lastly, check whether the delay mechanism fastening screws are tight.

To avoid the described malfunction, the latest modifications of the "Zorki-4" camera have a delay mechanism with a more durable plate. In the FED-3 and the "Leningrad" cameras, the mechanism has an additional dove-tail in front and is fastened with an additional screw.

This malfunction can also be caused by a defect in the exposure lever (see description in problem 6).

2. ***Malfunctions due to the mechanism becoming dirty.*** The delay mechanism does not work when certain parts are dirty or corroded. If they are, the gears do not move because sand particles are stuck between the teeth.

To correct the problem, remove the top plate *12* (Fig.206); turn the gear *9* (Fig.210) with two fingers in one direction and then in the other. This, however, is seldom sufficient for eliminating the malfunction. Your next step would be to examine and clean the mechanism gear teeth. If the mechanism does not work even after that, remove it and clean it with benzine without disassembling it. If the camera has been immersed in water, and the delay mechanism does not function due to corrosion of its parts, disassemble the mechanism and soak it in kerosene for some time. After the cleaning, the shafts and all the rubbing surfaces have to be lubricated with watch oil.

3. ***When pushing the shutter release button, the first curtain returns to the starting position and the second curtain does not move.*** This may occur even when setting the shortest shutter speed which does not involve the delay mechanism.

The second curtain is held by the slide-catch *10* (Fig.214a) which holds the bending of the lever *9*. The latter is secured on the coupling engaged with the second curtain drum. When all shutter speeds with the exception of additional speeds are being set, the delay mechanism is not wound, and its cam *4* (Fig.215) does not allow the slide-catch *10* (Fig.214a) to shift out. Let us consider setting a 1/2 sec shutter speed; the exposure lever *1* (Fig.213) is shifted to a shorter exposure time, for example, 1/100 sec. With this, the pin *3* is released, and the gears of the delay mechanism move out the slide-catch *10* (Fig.214a) and return to the starting position). But due to an incorrect position of the delay mechanism or dirt that has accumulated in it, the gears may remain still and not move the lever out.

This malfunction can also be caused by the shoulder of the cam *4* (Fig.215) missing the slide-catch *10* arm (Fig.214a) due to incorrect installation of the delay mechanism. If the delay mechanism is loose and shifts slightly, the cam will not hit the slide-catch shoulder and will not move it out; therefore, the second curtain will not move. To correct this problem, check the position and the fastening of the delay mechanism.

4. ***A long exposure time (for example, 1 sec) is set, but the shutter works as if it were set for a short exposure time.*** This is caused by a malfunctioning of the delay mechanism. As it was pointed out in discussing the design of the delay mechanism, the clutch device located inside the gear *13* (Fig.210 is responsible for the working and idle strokes of the mechanism. Sometimes oil gets on the clutch rollers, and they stop functioning, i.e., the mechanism is idle instead of making a working cycle. In this case, you ought to disassemble the delay mechanism, take out the gear *13* (Fig.210), and clean the clutch with benzine.

5. ***The malfunction of the slide-catch 10 (Fig.214a).*** The slide-catch located under the base *12*, shifts toward the cam *9* of the coupling. The screws *11* and *13* guide its movement. Sometimes the slide-catch does not shift out, or moves with difficulty due to an incorrect setting of the base *12*. If the slide-catch does not shift out, loosen the screw *14* by turning it 1-2 times. Alternately tightening the screws *11* and *13* by turning them 1/2-1 times, find a position when the slide-catch *10* moves easily. You can then tighten the screw *14*.

6. ***The malfunction of the exposure lever 1 (Fig.213).*** Sometimes it is impossible to install the exposure lever or it can be installed, but it then arbitrarily changes its position when the same speed is used again. Check the position and fastening of the exposure regulator pin. If the pin turns, its tip (see arrow in Fig.213) misses the corresponding mill in the exposure disk. That is what causes this problem.

Operational tips. Keep in mind that correct installation of the speed knob is important because the spring of the delay mechanism is wound by hand while the speed knob rotates. The speed knob should be turned only when the shutter is wound.

When the long exposure time is repeated, the delay mechanism spring is wound not by hand, but by the shutter speed mechanism. It is very important to wind the shutter mechanism smoothly and slowly.

Selftimer

The "Zorki-4" camera selftimer and its repair are the same as in "Zorki-2C" (see p.149). Note that adjustment and repair of the selftimer cam in the "Zorki-4" and "Mir" cameras are much easier than in other cameras of the same class.

The selftimer adjustment is done after removing the back plate (see Fig.259). More complex repair requires removing the body (see Fig.208). In later modifications of the "Zorki-4" and "Mir" cameras, the selftimer mechanism has one design improvement. The Figure 258 shows the parts of the release button. You can see that the button rod has a sharp tip. During the mechanism release, the button pushes aside the lever *4* (see Fig.175). In later modifications of the "Zorki-4" camera, the release button has a flat tip, not a sharp one. The selftimer mechanism has the spring *6* (Fig.208) bearing a sharp-tipped pin. The release button pushes the pin and the pin moves the release lever aside.

The most common malfunction of the selftimer mechanism is its arbitrary release described in Problem 2 on p.151.

The operational principle of the "Zorki-4" camera rangefinder is the same as that of the "Zorki" camera (see p.134).

Here are the main parts of the rangefinder: the block of prisms *2* glued together (Fig.215), prism lever *1* (Fig.210), prism *3*, and optical wedge *3* (Fig.215) installed in front of the prism. Compared to the "Zorki-3" camera rangefinder, the "Zorki-4" rangefinder has a number of advantages: the prism lever *1* (Fig.210) turns with the help of two metal balls, not on a shaft as is usually the case; one of the balls is positioned under the plate *4* and the other is underneath the lever *1*. Access to the prism *3* lever is not obstructed by other parts. It is very convenient for its adjustment. The prism *3* is not glued to the lever *1*, but is fitted in a moving mount which can turn vertically and horizontally. The prism lever can alternate its position due to the moving plate *4*.

The vertical adjustment is done by the optical wedge *3* (Fig.215) and prism *3* (Fig.210) after removing the top plate *12* (Fig.206). When a minor adjustment is required, it is done by turning the optical wedge (see optical wedge description on p.25). To do that, moisten a piece of cotton with alcohol and apply it to the optical wedge to dissolve the shellac glue used in mounting the wedge. The shellac gets dissolved in 10-15 minutes, and after that you can start the vertical adjustment. Focus the camera on any horizontal line at a distance of over 5 meters, turn the mount with the optical wedge by small angles (1-2°) until the still and moving images of the object coincide (the horizontal line in our case).

If the vertical adjustment cannot be accomplished by means of the optical wedge, continue the adjustment with the prism *3* (Fig.210) by turning its mount with the two set-adjusting screws *5* and *6*. They are set in shellac glue too, but it is not necessary to dissolve the shellac. To turn the mount with the optical wedge, untighten one screw by turning it 1/2-1 time and then tighten the second screw making the same number of turns. This procedure is repeated several times until the needed effect is achieved. Unscrew the screws carefully using a screwdriver with corresponding blade width. Avoid pressing their heads or else the prism lever will shift and the ball-bearing might fall out. If this should happen, unscrew the right screw fastening the plate *4*, shift the plate, and correct the prism lever position. Put the ball-bearing in the recess, carefully reinstall the plate and tighten up the screw.

The horizontal adjustment is done by the screw *1* (Fig.214a) and the cam *7* (Fig.208). If the camera is maladjusted only horizontally, there is no need to remove the top plate *12* (Fig.206). It is sufficient just to unscrew the screw *11*, insert a screwdriver in the hole, and find the screw *1* slot (Fig.214a). Turn the screw *1* by 3-5° until the moving and still images of the infinitely distant object coincide. If the moving image fails to reach the still image, tighten the screw *1*; in the reverse situation, untighten the screw *1*. Further adjustment is described in detail on p.137.

As a rule the horizontal adjustment of the rangefinder is required after its vertical adjustment.

"MIR"

The "Mir" camera (Fig.216) was designed on the basis of the "Zorki-4" camera and differs from it only in that it does not have an additional shutter speed mechanism.

Additional shutter speeds (1 sec, 1/2 sec, 1/4 sec, 1/8 sec, 1/15 sec) are not used by many photographers. Besides, the additional shutter speed mechanism is the most vulnerable part of the "Zorki-3M", "Zorki-3C", and "Zorki-4" cameras. Therefore, its absence makes the "Mir" camera more reliable in operation. “Mir” has many strengths and can be used by most demanding photographers, professionals and non-professionals alike. The "Mir" camera is equipped with the "Industar-50" lens in either a rigid or collapsible mount (see p.153), or with the "Jupiter-8" lens (see p.166).

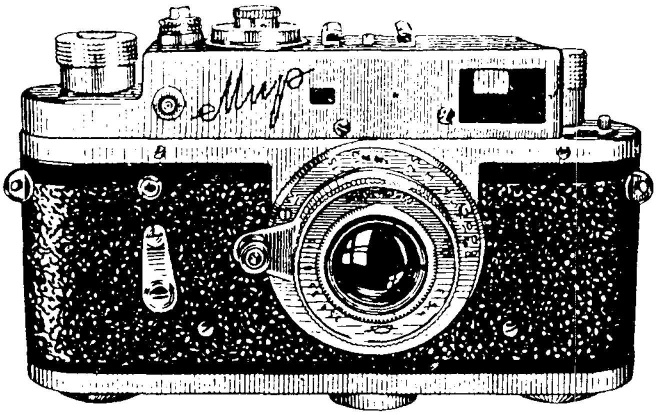


Figure 216. The "Mir" camera.

"ZORKI-5" AND "ZORKI-6" CAMERAS

The main characteristic feature of the "Zorki-5" and "Zorki-6" cameras is a winding lever (instead of a winding knob) for faster winding of the shutter without the need to move the camera away from the eyes.

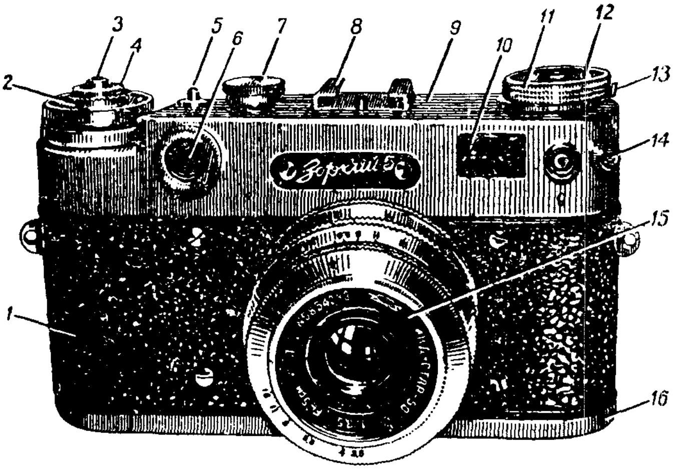


Figure 217. The "Zorki-5" camera.

The winding lever brought about changes in the design of the winding device which turned out to be a complex and vulnerable mechanism in the "Zorki-5" camera. The "Zorki-6" camera is an improved modification in this group of cameras. The camera's lever mechanism is wound easily and without force unlike winding the "Zorki-5" camera. Its malfunctions are much less common. Another advantage of the "Zorki-6" camera is that it has a selftimer mechanism and hinged back cover for convenient film loading and removing the exposed film. The hinged back cover invoked changes in the design of its body and other mechanisms.

The new body design with a hinged back cover proved to be advantageous in operation, and later models of reflex cameras such as "Crystal" and "Zenit-3M" had bodies of the same design.

The "Zorki-5" and "Zorki-6" cameras have a number of other advantages: their rangefinder and viewfinder are combined in a single field of view; they have dioptre sight correction, two flash sockets for pulsed flashes and disposable bulbs, and a film type and sensitivity reminder scale.

The cameras are equipped with the "Industar-50" (see p.153) in either a collapsible or rigid mount.

"ZORKI-5"

Major Exterior Camera Parts

The camera has the following exterior parts and assemblies: the body *1* (Fig.217), exposure counter dial *2*, shutter release button *3*, fastening nut *4*, switch-knob *5*, optical wedge *6*, shutter speed mechanism knob *7*, accessory shoe *8*, top plate *9*, rangefinder prism block *10*, film rewind mechanism knob *11*, film type index *12*, dioptre sight correction lever *13*, flash sockets *14*, lens *15*, and bottom plate *16*.

Camera Body and Bottom Plate

The camera body (Fig.218) is cast and sturdy. The top assembly plate holding all the camera mechanisms is fastened with two screws inside the body to two flanges on the sides of the body. The flanges have four threaded holes for the screws. Three of them (see arrows) are for fastening the assembly plate, and the hole *1* is for the long screw fastening the top plate *9* (Fig.217). These semi-circular flanges enhance the body's sturdiness.

The camera's bottom plate design is the same as in the "Zorki-2" camera. The plate lock (see Fig.164) opens the split cartridge used in the "Zorki-5" camera.

Exposure Counter

The "Zorki-5" camera exposure counter is as simple in design and reliable in operation as that of the "Zorki" camera.

The exposure counter actually consists of one part - the dial *2* (Fig.217). The limb is secured with a fastening nut *4* on top, and there is a spring washer under the dial. Every time the shutter is reset, the counter dial turns in the opposite direction to the movement of the winding lever. The dial makes a rotation one point short of a full turn.

The dial setting is considered correct if you need to apply some force to turn the dial with your finger. Free dial rotation is an indication of the exposure counter malfunction. To correct the problem, bend the spring washer more for greater pressure on the counter dial.

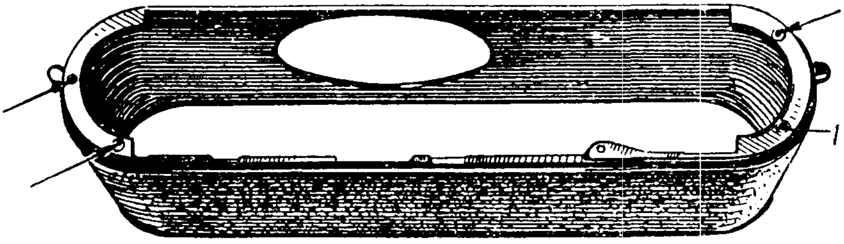


Figure 218. The camera body.

The exposure counter should be set to the first film frame only when the shutter is wound.

Film Type Indicator

The indicator consists of one part - the dial *12* (Fig.217) fastened with a screw to the rewinding shaft. When the screw is tightened, the dial has some vertical movement space that is filled by the spring washer located above it. The operational principle and repair of the film type indicator are the same as those of the exposure counter.

Partial Camera Disassembly

Most of the malfunctions of the "Zorki-5" camera can be corrected with partial disassembly. For partial camera disassembly, remove the top plate *9* and the body *1*. The top plate is removed first and the body second. Disassembling starts with unscrewing the fastening nut *4* and taking apart the winding mechanism. This is the most difficult part of the job.

The fastening nut *4* is very tight and has a small surface that is difficult to grip with a tool. Besides, the nut has a chromium coating which may be damaged. Unscrew the nut *4* with a special tool called cupropliers (see Fig.27) or with dental forceps. Bear in mind that it can only be done when the mechanism is wound. The nut *4* may have either left or right hand thread. You should therefore try both directions when unscrewing it. In general, it is difficult to tell whether a camera has left hand or right hand thread. It is observed, however, that cameras with the optical wedge *6* (Fig.217) located in their outer part (see Fig.217) have a nut with left hand thread, while cameras with the optical wedge located under the plate *9* have a nut with right hand thread.

Having unscrewed the nut, remove the exposure counter dial and the spring washer under it. Unscrew the black fastening nut *1* (Fig.219) that has holes for a tool and the same kind of thread as the nut *4* (Fig.217). The nut *1* (Fig.220) underneath the fastening nut has a right hand thread and two holes for the key. You should now remove the winding lever *2*, noting the way the end of the spiral spring is fastened on the gear *3* shaft base (see Fig.223). This spring returns the winding lever to the starting position after shutter winding.

The upper end of the spring enters a hole made in the lever base (see arrow in Fig.220). Its lower end is curved for hooking it to the screw *1* (Fig.221). You should next take off the winding lever, the spring, and the gear *3* (see Fig.223). After you have unscrewed two set screws, remove the shutter speed mechanism knob *7* (Fig.217); unscrew the viewfinder eyepiece and the screw, remove the dial of the film type indicator *12* and the spring washer located under it. The film wind knob *11* is fitted on the shaft. The knob can be unscrewed while the fork inside the camera is held with pliers. The removed fork falls out at the moment when the film wind knob is unscrewed.

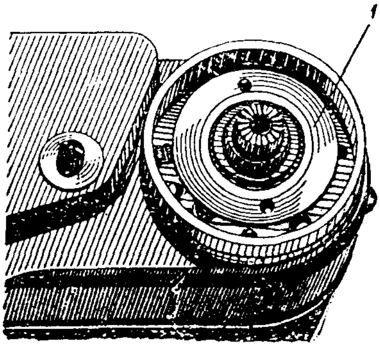


Figure 219. The upper parts of the lever mechanism.

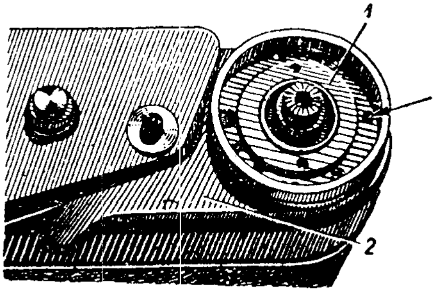


Figure 220. The lower parts of the lever mechanism.

There are a few special washers and a spiral spring inside the camera on the shaft. This spring takes up the shaft's looseness and prevents it from arbitrary rotation. The cartridge installation is adjusted by special washers. Prior to removing the knob *12*, you should observe and memorize the positions of the washers and the spring to be able to reinstall them correctly.

There is a disk underneath the film rewind knob. It is fastened with two screws that have to be unscrewed before the disk can be removed. It has a groove on the bottom which holds the handle of the dioptre sight correction mechanism. The handle itself can be taken out before the plate *9* (Fig.217) is removed or along with it. Once this is done, you can unscrew the screw *1* (Fig.221) and remove the top plate.

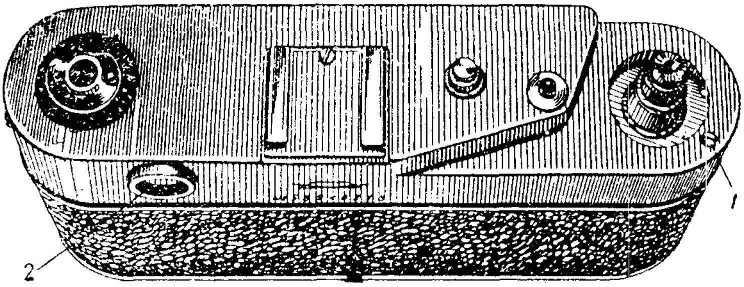


Figure 221. The top plate.

To remove the mechanism from the body, unscrew four screws and remove the lens mount ring. You will always find adjusting paper shims under the lens mount ring that have to be reinstalled during reassembly. Now is the time to unscrew the four chromed screws located on the outer side of the body and the three screws fastening the assembly plate 9 (Fig.228). While taking the mechanism out of the body, you must turn down the rangefinder lever with the cam with your left hand to avoid deforming it.

Lever Winding Mechanism and Brake Mechanism

The mechanism for shutter winding and film transport is the most complex and vulnerable assembly in the camera. It is the most frequent cause of malfunctions if compared to other camera parts.

Design and operational principle. The winding mechanism is assembled on the bridge *6* (Fig.224). The mechanism's gear system is driven by the winding lever *1* (Fig.222) when it is turned counter-clockwise. The lever catch *2* on the bottom the lever is pressed by the spring *3* against the ratchet *3* (Fig.223). Thus when the winding lever is turned, the two-tiered ratchet *3* starts turning as well. Through the gears *5* and *6* it involves the transport sprocket *7* (see Fig.226) and the friction clutch *4* of the take-up spool. With it, the transport sprocket pulls the film, and with the aid of the gear *6* engaged to the sprocket through the pin, it winds the focal plane shutter. Apart from the transport sprocket, the take-up spool set on the friction clutch *4* is also involved in the film transport. The system of driving gears is located underneath the bridge *6* (Fig.224) and rotates the take-up spool friction clutch.

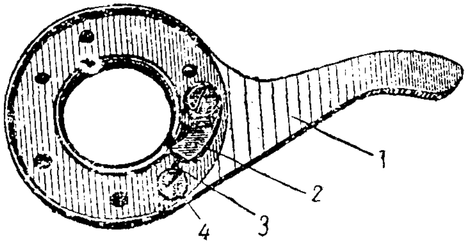


Figure 222. The winding lever.

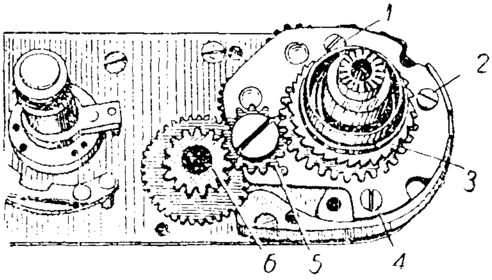


Figure 223. The winding mechanism.

The disk *7* connected with the release button *4* freely moves on the shaft *9* and serves for the shutter release. The release is done as follows. The lever *1* (Fig.225) is positioned under the bridge *6*; its lower end rests against the release spring *8* (Fig.229). When the release button *4* (Fig.224) is pushed, it causes the disk *7* to move. The disk depresses the shutter release rod's bending *1* (Fig.225) and lowers the spring *8* (see Fig.229). The spring *8* separates the pins of the transport sprocket 7 (Fig.226) and the gear *6*, and the shutter mechanism trips.

Mechanism disassembly. The repair of the winding mechanism is mostly done with partial camera disassembly (see p.184). For complete disassembly, i.e., for removing the mechanism from the camera, unscrew the special fastening nut *5* (Fig.226), take out the spring and friction clutch *4*, unscrew the screws *1*, *2*, and *4* (Fig.223), and remove the mechanism. There is a brass washer under the bridge. Be careful not to misplace it because it has to be reinstalled.

Malfunctions and repair of the mechanism. 1. ***The film is pulled with difficulty.***

This malfunction may be caused by different reasons. First of all, check the quality and fit of the cartridges (see p.17) because a bad cartridge is the most common reason for this defect. If the film unwinds from the cartridge with difficulty, do not install such a cartridge in the camera. The next step is to check if the film wind knob and fork turn freely. If they rotate with difficulty, find out the reason and eliminate it by oiling the shaft.

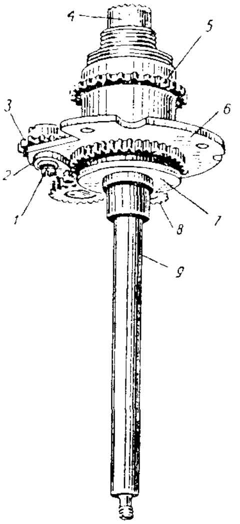


Figure 224. The parts of the winding mechanism.

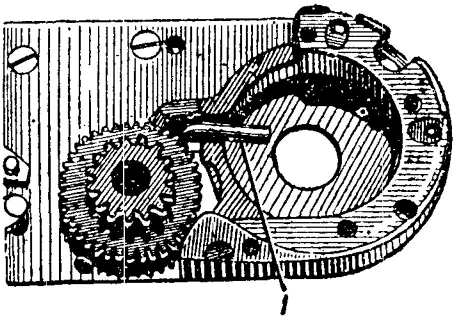


Figure 225. The shutter release lever.

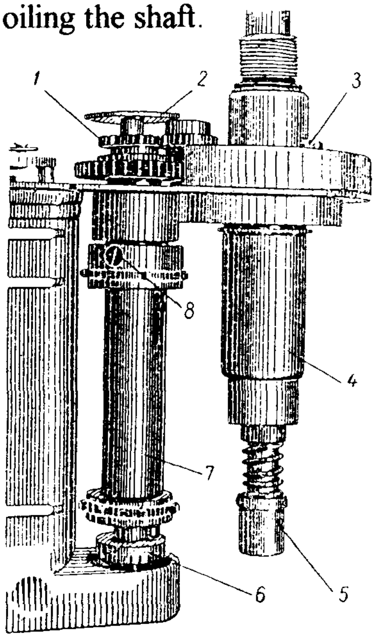


Figure 226. The parts of the transport sprocket and the take-up spool friction clutch.

Hampered winding of the film puts excessive load on the mechanism gears which causes the gear teeth to become deformed or brake. The transport of film stops, and shutter winding becomes impossible. Replace the damaged gears or fix their teeth (see p.38).

Sometimes winding is hard when there is no film in the camera. In such cases you may hear the gear making crackling sounds, while the winding is jerky. This problem is caused by the displaced bridge. The bridge should be positioned correctly with regard to the gear *6* (Fig.223). To fix its position, remove the top plate *9* (Fig.217) and untighten the screws *1*, *2*, and *4* (Fig.223) turning them once. Then shift the bridge in one direction or the other, tighten the screws, and check the mechanism's winding without putting back the top plate. During the installation of the winding lever *1* (Fig.222), make sure that the lever catch *2* is correctly set on the ratchet *3* teeth (Fig.223). The winding lever has a hole for installing the tool used to turn the catch.

2. ***Turning the winding lever does not wind the shutter.*** First, check the position of the shutter disengagement knob. You may sometimes fail to notice that the release button is in "Off"

position, i.e., the red dots on the button and on the rim are not matched. You should remove the lever *1* (Fig.222) and check the lever catch *2*. If the spring *3* is not in place, the catch stops functioning. Then the winding lever moves easily without an overload during the winding of the shutter.

3. ***The curtains return to their starting position during the shutter winding.*** When it is wound, the mechanism's fixed position is ensured by the lever catch *2* (Fig.224). The catch is pressed by the spring and turns around the shaft *1*. Sometimes the spring snaps off the catch, and the latter stops functioning. Partially disassemble the camera (see p.184), remove the bridge, and check the catch.

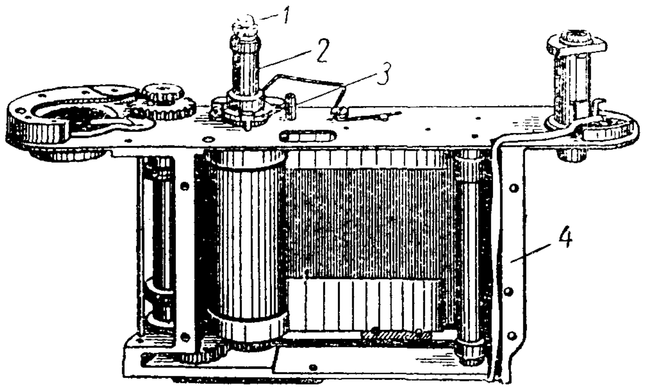


Figure 227. The focal plane shutter.

This malfunction may be caused by other, more serious matters. The pair of gears *6* (Fig.223) may be damaged. It consists of two parts: the upper gear of a smaller diameter and the shaft comprise the first part, while the second consists of the lower gear of a larger diameter pressed on the shaft. If the lower gear starts to turn, the described defect can occur.

The curtains may not return all the way to their starting position during the shutter winding. If they stop even a few millimeters short, it is enough for the shutter speed mechanism to cease functioning (see pp.113, 115).

To eliminate the malfunction, remove the gear *6*. It requires partial camera disassembly (see p.184) and removing the bridge. Then unscrew the screw *8* (Fig.226) and remove the gear. Put the gear on a hard surface and make several strokes with a center punch and a hammer in the area around the joint of the lower gear and the shaft.

This malfunction may also be caused by poor engagement between the two couplings located inside the transport sprocket *7*.

Mechanism-Switch for Film Rewind

There is a mechanism-switch for rewinding of the exposed film in the camera. Its design is identical to the mechanism in the FED-2 and "Zorki-C" cameras.

When the transport sprocket *7* (Fig.226) is disengaged from the gears *1* and *6*, it can rotate freely. To put the sprocket out of gear, push the knob *5* (Fig.217). Its motion is transferred to the rod *2* (Fig.226). The rod *2* separates two couplings located inside the transport sprocket *7*. The lower coupling has two pins, and the upper coupling has two slots. The upper coupling is the shaft of the two-tiered gear *1*. It cannot move vertically. The lower coupling is mobile and is driven by a spiral spring. When the knob *5* (Fig.217) is pushed, the lower coupling goes down and the couplings separate. The pins of the gear *6* and the transport sprocket become simultaneously separated, too.

Sometimes the pins and slots of the couplings, the upper one in particular, wear out and the curtains snap off during the winding. (See Malfunction 3 in the preceding section.) The gear *1* (Fig.226) must be removed, examined and corrected with the help of the file for the coupling slots. If it is impossible to correct the problem this way, remove the lower coupling and fix its pins.

Focal Plane Shutter

The design of the curtain mechanism (Fig.227) and of the shutter speed mechanism are identical to corresponding assemblies of the FED camera.

Let us consider some features of the "Zorki-5" camera shutter disassembly. The first step is to remove the rangefinder fastened with four screws *1*, *2*, *3*, and *5* (Fig.228) to the top assembly panel. The shutter body *4* (Fig.227) is fastened to the assembly panel with four screws as well. Three of them are located under the base of the viewfinder-rangefinder, and the fourth screw is on top of the assembly panel. Before removing the shutter body, disassemble the shutter speed mechanism and remove the flash synchronization mechanism's contacts. To do that, unscrew the index *1* that has a hole for a tool, remove the lever with the pin *2* (there is a spiral spring inside), unscrew the screw and remove the shutter speed disk *3*. Then take out the catch *6* (Fig.228) and remove the insulating plate *3* (Fig.229) with the contacts. There is no need to remove the flat spring *8*. It is sufficient just to separate it from the release shaft *9*. To do that, completely unscrew the screw *1*; untighten the screw *2* and shift the spring *8* so as to position the

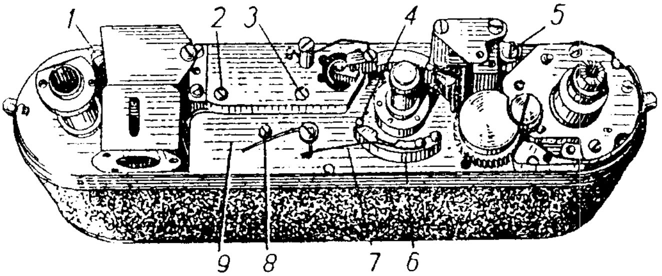


Figure 228. The assembly panel.

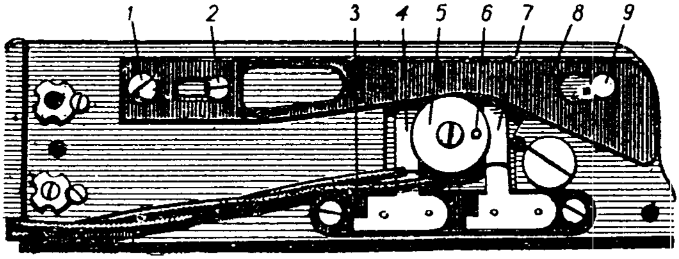


Figure 229. The flash synchronization mechanism.

end of the shaft *9* opposite the wide part of the hole in the spring *8*. Now the shutter can be removed.

All shutter malfunctions and their elimination are described in detail in the chapter on the FED camera.

Some shutter malfunctions common for "Zorki-5" camera. 1. ***All shutter speeds are equal.*** This malfunction is caused by the incorrect position of the lever catch *6* (Fig.228). If the spring *7* is displaced or the catch jumps over the set screw *4*, it stops functioning. Sometimes this malfunction is manifested somewhat differently, for instance, when the curtains stop during the shutter operation.

Partially disassemble the camera and put the catch *6* back in its place (see p.184).

2. ***The shutter speed mechanism knob 7 (Fig.217) is displaced.*** To set the "B" speed, turn the knob to position the index "B" opposite the dot on pointer *1* (Fig.227) and tighten the set screws located around the knob.

Flash Synchronization Mechanism

There are two sockets for the flash on the camera. The camera has no synchrocontroller. The insulating plate *3* (Fig.229) has two flash synchronizations *4* and *7*. The disk *5* is permanently fixed on the shaft of the curtain drum and rotates along with the drum. Its contact *6*, in turn, closes the circuit in the contacts *4* and *7*. First, the disk contact closes the electric circuit of the disposable bulbs, and then it closes the pulsed flash at the moment of the shutter's complete opening.

Do not detach the flash synchronization wires during shutter disassembly. Remove the insulating lath *3* with the contacts, and put it back in during reassembly. You should not forget the insulating washers on the ends of the contacts under the release spring *8*.

Damage to the flash synchronization mechanism is uncommon. Sometimes the disk *5* is displaced along with the contact *6*, or the contacts are deformed. Install the disk *5* as shown in Figure 229 (when the shutter is released) and tighten the disk fastening screw.

Viewfinder-Rangefinder

The viewfinder-rangefinder is assembled on the base *2* (Fig.230) which is fastened to the assembly panel with the screws *1*, *2*, *3*, and *5* (Fig.228). The base is removed only for shutter disassembly so do not remove it during rangefinder repair.

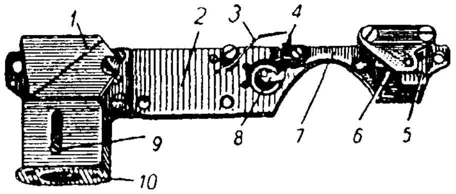


Figure 230. The viewfinder-rangefinder.

The viewfinder-rangefinder consists of the eyepiece *2* (Fig.221), block of prisms which are glued together *1* (Fig.230), cam *8*, prism lever *7*, prism *6*, and optical wedge *6* (Fig.217). The rangefinder's design is the following (see p.22): the glued prism block consists of two prisms glued together, and the joint is coated with a beam-splitting layer (see dotted line in Fig.230) at a 45° angle relative to the eye. The glued prism block is fixed while the prism *6* rotates (two balls located underneath and above the prism lever *7* serve as a shaft for the prism). The cam *8* is connected with the lens mount and the prism lever *7*. The prism *6* can be turned vertically and horizontally.

The rangefinder is adjusted as follows. The vertical adjustment is accomplished with the optical wedge *6* (Fig.217). The location of the optical wedge varies. In earlier camera modifications, the optical wedge was positioned under the top plate *9* and it was necessary to remove the plate *9* for the adjustment. In later camera modifications, the optical wedge is located outside the top plate (see Fig.217), and the plate does not have to be removed. Unscrew the chromed optical wedge rim and adjust the optical wedge. The horizontal adjustment is done with the screw *4* (Fig.230) and the cam. The rangefinder adjustment is described in detail in the chapter on the FED camera (see p.136).

When the vertical adjustment cannot be done with the optical wedge, it should be done with the prism *6*, as in the "Zorki-5" camera. Remove the top plate *9* (Fig.217) and adjust the prism using the two set-adjusting screws *5* (Fig.230). Before tightening one screw, loosen the other by the same number of turns. The screws should be turned at small angles (1/3-1/2 turns).

Dioptre Sight Correction

The dioptre sight correction device serves for adjusting the viewfinder-rangefinder to the photographer's eyesight. The device consists of one lens element set in a moving tube. The dioptre sight correction lever *13* (Fig.217) is connected with the moving lens element through the screw *9* (Fig.230) in the moving tube.

Mechanism malfunctions. 1. ***The lever 13 (Fig.217) turns with difficulty.*** The lever *13* turns with difficulty if the movement of the tube with the dioptre sight correction lens element is hindered. You should remove the top plate *9* and oil the tube.

2. ***The lever 13 turns, but focusing does not occur.*** This happens when the screw *9* (Fig.230) has fallen out, or the lever *13* (Fig.217) has become deformed.

Lens

The "Zorki-5" camera is equipped with the "Industar-50" lens in either a collapsible or rigid mount (see p.153). The lens and body adjustment is done in the same manner as for the FED camera (see p.131).

Tips on Camera Operation

In the "Zorki-5" camera, the shutter should not be wound when the lens is unscrewed because this can damage the rangefinder. Besides, the shutter may not function without the lens, and it may seem that the shutter is damaged.

The winding lever *2* (Fig.220), driven by a spring, returns to its starting position after the winding of the mechanism. If the lever *2* is released, it hits the top plate *9* (Fig.217) with considerable force. Such blows can damage the mechanism and the rangefinder. Therefore, it is recommended to return the lever to its starting position smoothly. A piece of rubber tubing may be put on the lever to decrease the impact on the plate. A rubber pad is installed on the lever in the "Zorki-6" camera for this purpose.

"ZORKI-6"

The "Zorki-6" camera (Fig.231) is an improved version of the "Zorki-5" camera. The principles of its design and operation are the same as for the "Zorki-5" camera. We will therefore discuss only the changes and additions of the "Zorki-6" camera design.

Partial and Complete Disassembly and Reassembly

In writing this book, much attention was paid to partial and complete disassembly and reassembly of the "Zorki-6" camera. This is due to the fact that this camera has a unique feature - the shutter body and the camera body are one molded part. Therefore, the assembly sequence of the focal plane shutter is radically changed.

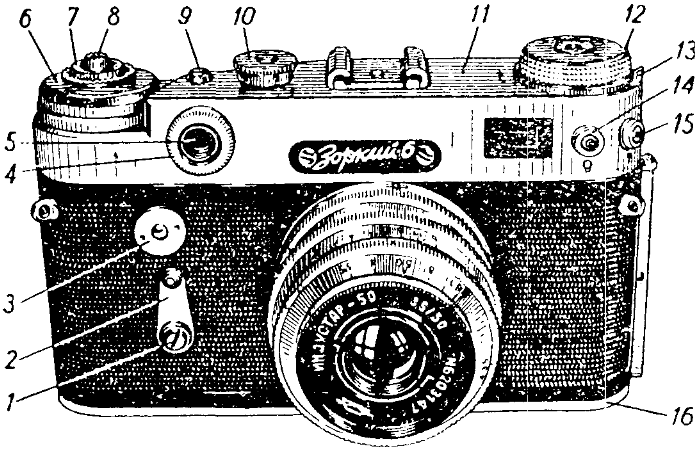


Figure 231. The "Zorki-6" camera.

The disassembly and reassembly sequence for all the other camera parts depends on the design and assembly of the shutter. A similar design of the body and the shutter was also used in other contemporary cameras - "Crystal" and "Zenit-3M".

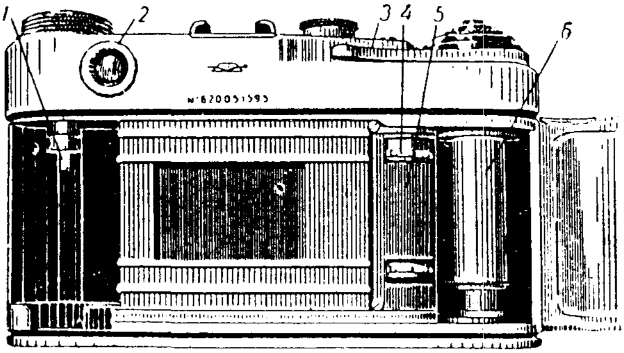


Figure 232. The film track.

Most repairs are conducted when the camera is partially disassembled. This kind of disassembly includes the removal of the top and base plates *11* and *16* (Fig.231) as well as that of the take-up spool *6* (Fig.232).

Many of the "Zorki-6" camera repairs require removal of the take-up spool. In order to remove it, unscrew the four decorative screws and remove the base plate *16* (Fig.231). Unscrew the screws *9*, *10*, and *11* (Fig.233) next, and remove the tripod nut *8* while centering the end of the take-up spool. The slot of the screw *10* (see Fig.234) can be seen on the end of the take-up spool. It has to be unscrewed in order to enable you to remove the take-up spool *7* which includes the friction clutch *8*, its base *6*, screw *10*, and spring *9*.

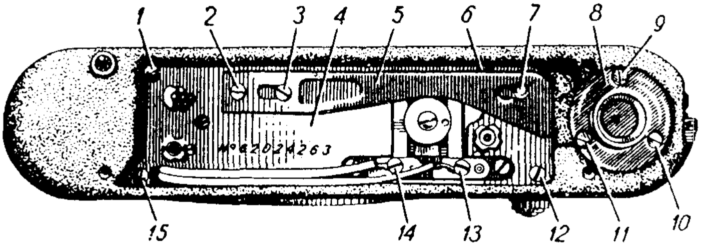


Figure 233. The focal plane shutter panel.

To remove the shield *5*, which covers the selftimer mechanism, unscrew the screws *1*, *4*, *11*, and *12*. These parts can be disassembled without removing the top plate *11* (see Fig.231).

The top plate *11* is removed as follows. When the shutter is wound, unscrew the special nut *7* with ***a left hand thread***. A tool for unscrewing the nut is shown in Figure 27. Remove the exposure counter dial *6* and the spring washer under it. Then unscrew the black nut 1 (Fig.219) which has a left hand thread as well. Lift the winding lever *3* (Fig.232), release the spring hooked by its bending to the lever, and remove the lever. The lever and its catch are shown in Figure 222. Lastly, remove the knob *12* (Fig.231).

There is a screw in the center of the knob. Unscrew it and remove the film type reminder scale and spring washer. Next unscrew the knob while holding the fork *1* (Fig.232) with pliers. There are three screws under the knob; unscrew them and remove the disk. Carefully observe the position of this disk for future reinstallment. If it is reinstalled incorrectly, the lever *13* (Fig.231) will turn with difficulty. Unscrew the two set screws and remove the shutter speed mechanism knob *10*. Unscrew the eyepiece *2* (Fig.232), the rim *4* (Fig.231), the optical wedge *5*, and the screw under the lever *3* (Fig.232). Having done all of this, you may remove the top plate. The lever *13* (Fig.231) of the dioptre sight correction mechanism should be removed and reinstalled simultaneously with the top plate during reassembly.

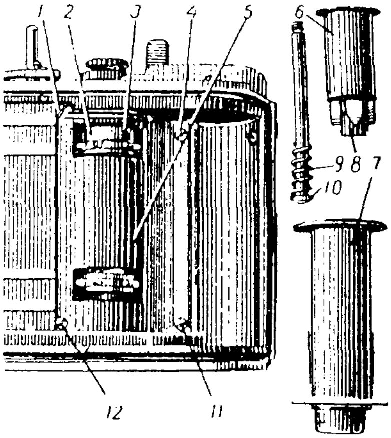


Figure 234. The transport sprocket and the friction clutch of the take-up spool.

In the "Zorki-6" camera, the flash sockets *14* and *15* (Fig.231) are connected with the contact mechanism in two ways. Some cameras have flash sockets connected to the contacts with wires soldered to them (see Fig.227); other models have wires with connectors (see Fig.235) on their ends, and these connectors are put on the internal rods of the flash sockets. If a camera has flash sockets connected by the second method, the top plate should be freed from the wires after it is removed, i.e., the connectors have to be removed, and the positions of the wires must be memorized (the wires are colored differently).

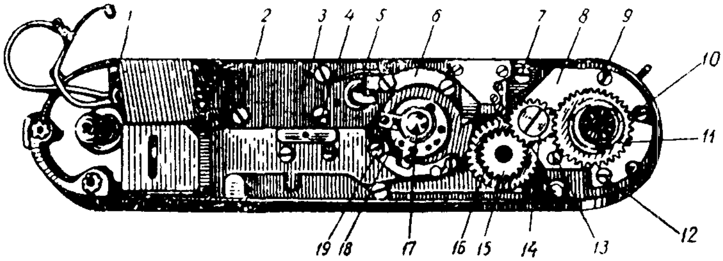


Figure 235. The assembly panel.

To remove the bridge *8* (Fig.235), remove the friction clutch of the take-up spool (Fig.234) and unscrew the screws *9*, *10*, *12*, and *13* (Fig.235). Remove the washer set under the screw *10*, and install it at reassembly. It prevents the top shaft of the hinged cover from falling out. To remove the block of the gears *15* and *16*, remove the bridge *8* and unscrew the screw *3* (Fig.234) which connects the transport sprocket *2* with these gears.

When disassembling completely, unscrew the pointer *17* (Fig.235) set over a spiral spring, remove the exposure lever *19*, unscrew the screw, and remove the exposure disk *18*. Then unscrew the screws *13* and *14* (Fig.233) and free the flash synchronization wires. To remove the plate *4* with the shutter, unscrew the four screws. Three of them (screws *1*, *12*, and *15*) are located on top, and the fourth one (screw *6*) is under the release spring *5*.

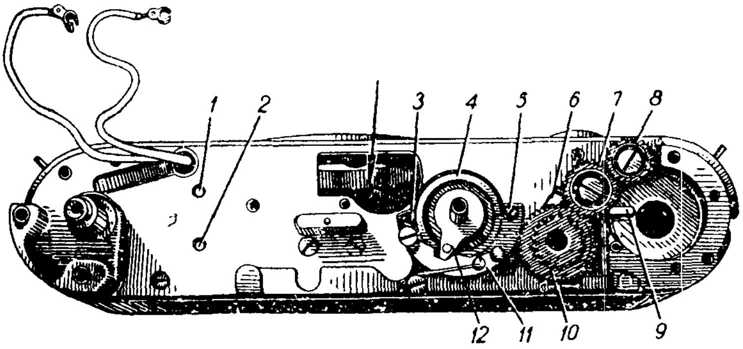


Figure 236. The assembly panel without the rangefinder.

As is pointed out in the description of the "Zenit-C" camera disassembly on p.230, removing the release spring should generally be avoided. In the camera that is now being described, the spring *5* also should not be removed. Unscrew the screw *2* and untighten the screw *3* by turning it once. Move the spring *5* slightly forward to position the end of the shaft *7* opposite the wide part of the hole. Then lift the spring a little and unscrew the screw *6*. Also unscrew the screw *1* (Fig.231) and remove the handle *2* with the adapter.

The assembly of the focal plane shutter is complex and requires certain skills. Thus shutter disassembly is done only when absolutely necessary. Before reassembling the shutter, familiarize yourself with the design and assembly of the FED camera shutter (see p.115) paying particular attention to the coupling *1* (Fig.135) and its connection with the curtain drum.

One feature of the design of the "Zorki-6" camera should be noted. In the preceding models, the coupling was installed in the socket of the assembly plate and was not removed. In the "Zorki-6" camera, the camera body and the shutter body are combined into one part which significantly complicates the reassembly of the shutter because it has to be installed from the bottom, and it is difficult to match the pin of the coupling with a hole in the curtain drum. To make assembly easier, the coupling in the "Zorki-6" camera is removable. The disk *4* (Fig.236), which holds the coupling in its hole, is fastened with the screws *3* and *5*. Before reassembling the shutter, remove the disk and reinstall it when the shutter is assembled, i.e., after the base plate *4* (Fig.233) is installed.

When the disk *4* (Fig.236) is installed, the coupling pin should be in the hole on the curtain drum. The hole has to be on the left side of the pulley segment gear (see the upper arrow in Figure 134 and the description of the assembly on p.118).

Mechanism assembly is considered correct if the cam *12* (Fig.236), secured on the coupling square, is in the position shown on Figure 236, i.e., approximately in the center of the recess of the lever-catch *11*. This is the position of the cam *12* when the shutter is wound.

In addition, to make the installation of the shafts of the curtain bushing sleeve in the sockets *1* and *2* (Fig.236) easier, remove the rangefinder. All the parts of the rangefinder are assembled on the base fastened with the screws *1*, *2*, *4*, and *7* (Fig.235). When installing the rangefinder, put the lever with the cam in the hole (it is marked with an arrow in Fig.236). Pay attention to the location of the spring *5* (Fig.235). One end of the spring is resting against the screw *3*, and the other is resting on the prism lever *6*.

Film Track and Hinged Cover

The hinged cover (Fig.237) turning on the joints opens an access to the film track (Fig.232). Make sure the cover is not deformed and does not squeeze the film.

The cover has a lock-lath. If the lock base is loose, unscrew two screws on the outer side of the lath (they are not shown on Fig.237) that are screwed in the openings of rivets *1* and *2*.

Secure the rivets and install the lock base.

The cover turns on two hinges located under the top and base plates of the camera. "Zorki-6" camera has a cartridge of a new type (its design is described in details in the camera manual). Regular cartridges can be used as well, but manufacturer's cartridge is better because the film unwinds from this cartridge easily which is crucial for normal camera operation. The film is pulled by the transport sprocket *4* (Fig.232) and is reeled around the take-up spool *6* set on the friction clutch. Exposed film is rewound back into the cartridge.

Normal film transport in either direction depends on the functioning of three camera units: rewinding fork *1* (Fig.232), transport sprocket *4*, and take-up spool *6*.

Malfunctions of the rewinding fork, transport sprocket, and take-up spool. 1. ***The film rewind knob 12 (Fig.231) does not go up or down.*** This is one of the most common camera malfunctions. The film rewind knob is set on the fork *1* (Fig.232) shaft. To prevent free vertical shaft shifts, there is a special device consisting of the screw *2* (Fig.238) set over the spiral spring and metal ball. The ball is pushed by the spring and can move within the opening holding the screw *2*. Fork *1* shaft has two beveled grooves where the ball moves to up and down positions of the film rewind knob. Because the fork shaft is made of metal softer than the ball and it rotates during camera operation, a worn out notch forms in the location of the ball.

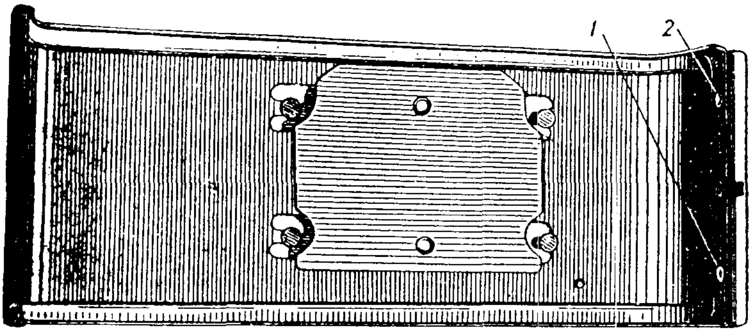


Figure 237. Hinged cover of the camera.

Replace the shaft or file beveled grooves to get rid of the notch. To do that, remove the top plate, unscrew the screw *2*, take out the spring and the ball, and remove the fork with the shaft.

Similar problem occurs in "Crystal" and "Zenit-3M" cameras.

2. ***The take-up spool 6 (Fig.232) does not reel the film well.*** In that case, strengthen the take-up spool friction clutch. Disassemble the friction clutch (see Fig.234) and slightly stretch the spring *9*.

3. ***The transport sprocket does not pull the film.*** Refer to item 3 on p.188 and "Zorki-5" camera brake design.

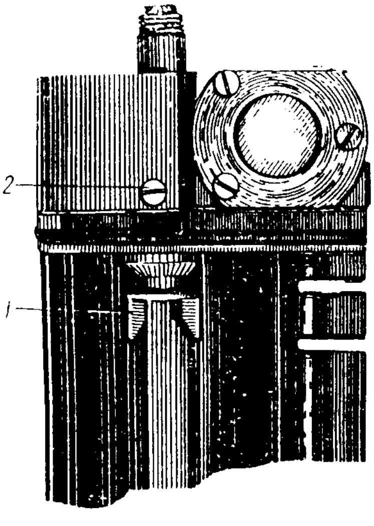


Figure 238. The rewinding fork and shaft.

Winding Mechanism and Brake Device

Winding the shutter and film rewinding are done with a turn of the lever *3* (Fig.232). The pawl *2* (Fig.222) rotates the gear *11* (Fig.235) that rotates gear *15* and *16* through the gear *14*. The shaft of these gears ends with two slots holding the switch mechanism bushing *8* (see Fig.248) pins. Refer to p.145 for details on the switch mechanism. The transport sprocket *4* (Fig.232) is turned by the bushing *8* (see Fig.248).

In addition to the transport sprocket, take-up spool friction clutch should rotate as well. It is achieved as follows. The gear *10* (Fig.236) rotates the gears *7* and *8* located under the bridge (Fig.236 shows the camera with the bridge removed). The gear 8 turns the gear *2* (Fig.239) located under the bridge as well. The gear *2* is fastened on the shaft *4*; the screw *10* (Fig.234) is screwed in the shaft's end. Possible failures of this assembly are discussed in Malfunctions 2 and 3 in the description of the analogous assembly in the "Zorki-5" camera (see p.187).

The disk *3* (Fig.239), connected with the release button *1*, can move along the shaft *4*. When the release button is depressed, the disk *3* presses the bending *9* (Fig.236) on the rod *3* (Fig.240), which releases the shutter.

The brake device prevents the curtains from returning to their starting position after the winding of the shutter. The brake of the "Zorki-6" camera is simple and reliable. There is a lath with the bending *6* (Fig.236) under the gear *10*. The bending *6* is located next to the gear teeth. When the shutter is being wound, the gear *10* rotates counter-clockwise, and the fold shifts away from the gear *7*. When the winding stops, the gear *10* is driven to turn clockwise, but the bending *6* gets on the teeth of the gear *7* and prevents the gears from turning.

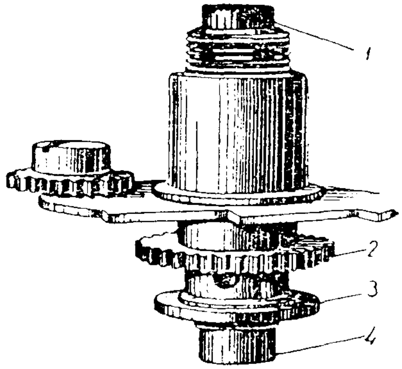


Figure 239. The winding mechanism bridge.

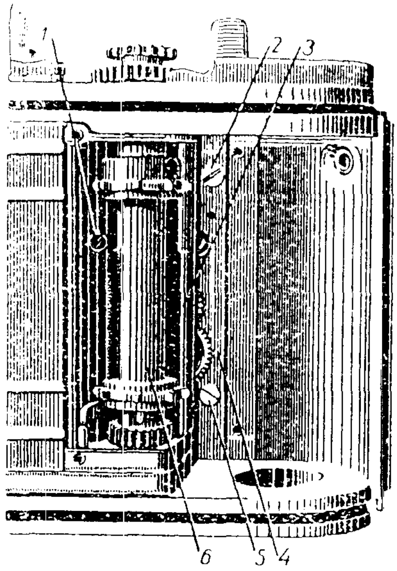


Figure 240. The selftimer mechanism.

Mechanism malfunctions. ***After the winding of the shutter, the curtains return to the starting position or slightly shift in the opposite direction.*** This is enough to hinder the operation of the shutter speed mechanism.

There could be different reasons for this problem. One of them is the deformation of the fold *6* (Fig.236). Remove the top plate, examine the fold, and straighten it. Another possible reason for the malfunction is described in item 3 on p.188.

Shutter and Selftimer

The "Zorki-6" camera shutter is analogous to that in the FED camera (see p.115). The only difference is in the disassembly and reassembly sequence of the shutter described above.

The selftimer mechanism, as well as its design and repair are described on p.149.

To adjust the selftimer, remove the base plate *16* (Fig.231), the take-up spool, and the shield *5* (Fig.234) after unscrewing the screws *1*, *4*, *11*, and *12*.

If it is necessary to remove the selftimer *4* (Fig.240), unscrew the screws *1*, *2*, and *5*. Do not remove the transport sprocket *6*.

FED-2, "ZARYA", AND FED-3 CAMERAS

FED-2 was the first camera developed in this group and is an improved version of the FED camera.

It has a number of advantages over the FED camera. The body is very sturdy because the body and the back cover are molded under pressure. Its split body simplifies camera loading and lens adjustment, and allows convenient extraction of the exposed film. The rangefinder and viewfinder are joined in a single field of view. The dioptre sight correction mechanism allows for custom adjustment of the viewfinder-rangefinder by eyesight within ±2 dioptres. Changeable optics can be used with the camera.

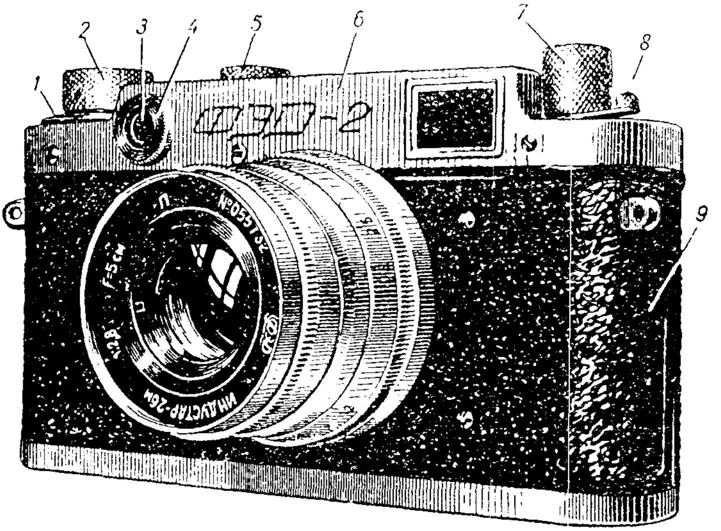


Figure 241. The FED-2 camera.

The camera's design underwent constant improvements, which is why there are several models of the FED-2 camera. The first modification had the "Industar-10" lens (see p.128), while later cameras were equipped with the fast "Industar-26M" lens. Earlier models did not have a flash synchronization device, selftimer, etc., added later.

The "Zarya" model is just a simplified version of the FED-2 camera without a rangefinder. FED-3 is practically identical to the FED-2 camera but has an additional shutter speed mechanism.

The adjustment of cameras in this group (body and lens adjustments) is described on p.131.

Major Exterior Camera Assemblies and Parts

The camera consists of the body *9*, exposure counter dial *1* (Fig.241), winding knob *2*, optical wedge *3*, optical wedge rim *4*, shutter speed mechanism knob *5*, top plate *6*, film rewind mechanism knob *7*, and dioptre sight correction handle *8*.

Camera Body

The removable back cover makes it very convenient to examine and repair some of the camera's mechanisms and parts.

For example, film movement in the film track can be viewed without taking the mechanism out of the body; the take-up spool can be adjusted; the transport sprocket operation can be checked; the curtains can be checked for light-proof; speeds can be examined and corrected if necessary, etc.

The molded FED-2 camera body is much sturdier than that of its predecessor, and this is very important for reliable camera operation. The FED-2 camera body practically never needs repair.

Removable Back Cover

The back cover *1* (Fig.242) is molded, very sturdy and almost never breaks or deforms. It holds the support plate *4*, the tripod socket *3*, and two locks *2*.

The support plate that is fastened on a spring presses the film against the frame window. The spring is fastened with four figured rivets. With respect to the frame window of the shutter body, the support plate should have some space for movement to prevent jamming of the film. Sometimes the support plate has insufficient space for movement. It makes it hard to wind the shutter and transport the film and may cause double frame exposure.

The movement is checked as follows: set the shutter speed mechanism knob to the "B" speed, depress the release button, and turn off the film rewind mechanism while still holding the button. If the shutter is open, the first curtain returns to its starting position, while the second curtain remains in place. Remove the lens, then depress the support plate carefully with your thumb and check whether it has sufficient movement space. If the movement space of the support plate is insufficient, straighten out the cover.

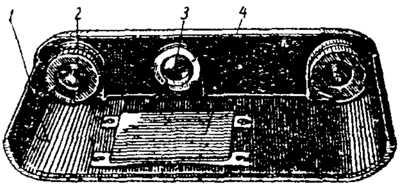


Figure 242. The removable back cover.

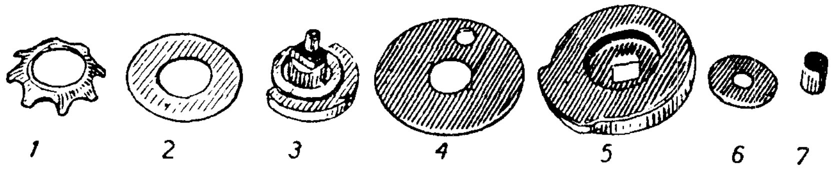


Figure 243. The parts of the cover lock.

The removable cover has an opening for the tripod socket with an 3/8'' thread. If the fastening nut becomes loose, the tripod socket falls out or remains screwed on the body nut. A tight body nut often unscrews along with the tripod socket, thus it should not be tightened too much.

There are two types of locks. The lock of the first type consists of the spring washer *1* (Fig.243), chromed washer *2*, cramp with shaft *3*, steel washer-shim *4*, lock *5*, washer *6*, and pin *7*. (Lock parts are listed in the same sequence as they are assembled.)

The locks *5* have different shapes: one is intended for the cartridge and the other is for the spool, and they should not be interchanged.

This type of the lock has two most common malfunctions: the pin *7* becomes loose and, as a result, the lock falls apart, or the square hole in the center of the lock *5* becomes deformed.

The lock is assembled as follows: insert the spring washer *1* in the lock hole on the outer side of the cover; put the chromed washer *2* over it; finally, install the cramp with the shaft *3*. The cramp has to be in the "Closed" position. Then flip the cover while holding the cramp with the shaft with your left index finger. Put the steel shim *4* on the inner side of the cover to insert the cut tip on the cover into the hole in the shim. Set the lock *5* in the "Closed" position. To determine the "Closed" position correctly, set the second functioning lock in the "Closed" position as well and compare their positions. Having installed the lock, put back the washer *6* and tighten up the pin *7*. In later camera modifications, the set screw prevents the fastening pin *7* from becoming loose; therefore, the set screw located on the end of the pin *7* has to be tightened up.

The lock with the second type of design is identical to the lock in the "Kiev" camera (see Fig.316). For a detailed description of its assembly see p.252.

These locks mostly share one problem - the shaft of the lock for the cartridge may break, and then the lock has to be replaced with a new one.

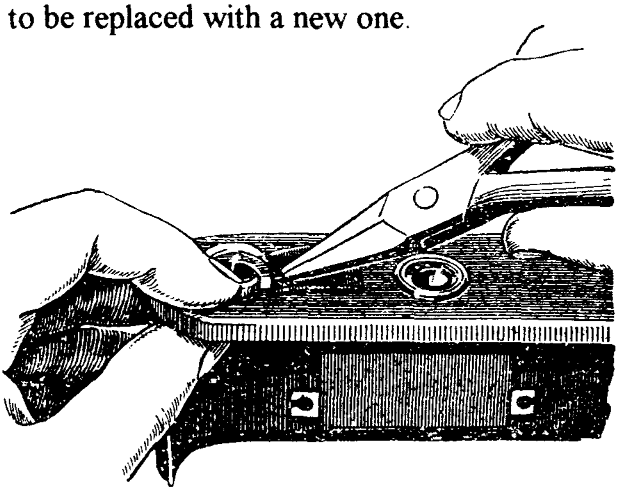


Figure 244. The installation of the lock rod.

When assembling the lock, push the rod in with pliers (see Fig.244). To avoid damaging the chrome coating of the cover, put a thin foil pad underneath the rod.

Take-Up Spool

As it was pointed out earlier, insufficient space for the movement of the support plate *4* (Fig.242) disrupts normal film transport. The same problem may be caused by poor fitting of the take-up spool that is crucial for normal transport of film.

In the FED camera description, the operational principle of the take-up spool was discussed in detail. All of this fully refers to the FED-2 camera as well. An incorrect position of the take-up spool may cause the following FED-2 camera malfunctions.

1. ***The film is advanced only up to the 20th-25th frame and then starts exposing one frame over the other or stops completely.*** To correct this defect, tighten the take-up spool setting on the transport sprocket and slightly wind the sprocket springs (see Fig.120).

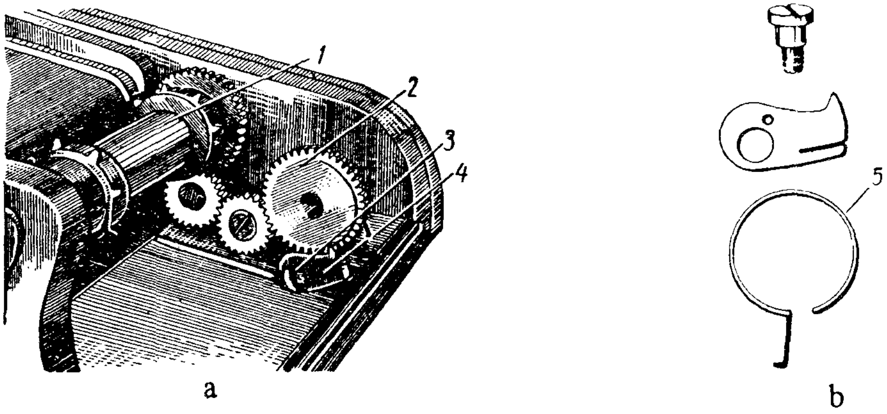
If the transport sprocket itself is loose on the shaft (which happens less frequently), unscrew the screw-shaft, remove the spiral spring and slightly wind it. This is how correct sprocket setting is achieved. Make sure that the side flanges of the spool are not deformed.

2. ***The film is reeled around the transport sprocket instead of the take-up spool.*** This problem is caused by the same reasons as the preceding malfunction so the method used to correct it is the same.

It should be added that a new take-up spool has to be checked and adjusted if necessary.

Ratchet Catch

Shutter winding increases the winging of the spring in the curtain bushing sleeves, and the curtains are driven to return to their starting position. To prevent it, the camera has the pawl *4* (Fig.245a) which permits getting the mechanism fixed while winding the shutter and in its wound position. The pawl in the FED-2 camera replaces the brake spring in the FED camera. The pawl is far more reliable than the brake spring, and it is located conveniently in terms of repair.



a

b

Figure 245. The brake device:
a - the pawl installed in the camera; b - the parts of the brake device.

The pawl *4* becomes visible after the take-up spool is removed. The Figure 245a shows it with the take-up spool drum removed as well. The pawl has two holes. One of them contains the ledged screw *3* used for turning the pawl and fastening it to the body. The bending of the spring lever *5* (Fig.245b) hooked to the winding gear *2* shaft base (Fig.245a) is inserted in the second hole. When the shutter mechanism is being wound, the winding gear rotates and involves the spring lever that shifts aside the pawl *4*. Once the pawl has turned, it no longer obstructs the rotation of the gear *2*. When the mechanism's winding stops, the winding gear is driven by the curtain springs to its starting position. However, at the very same time the spring lever turns the pawl in the opposite direction, its tooth gets between the gear teeth and prevents it from rotation. In this way it keeps the curtains mechanism in the wound position. This is the pawl's operational principle.

Pawl malfunctions are manifested by the fact that the shutter does not remain in the wound position, and the curtains arbitrarily return to the starting position. The shutter speed mechanism's operational principle is described in detail on p.114. The mechanism's work is closely connected with the operation of the pawl, and malfunctions in the latter immediately cause problems in the shutter speed mechanism functioning.

The failure of the pawl is brought about by the arbitrary untightening of the screw *3*. First of all, the screw 3 has to be retightened and lubricated. If this does not fix the problem, the pawl tooth needs to be checked, for it may be deformed or even broken off. If that is the case, the following steps have to be taken. The pawl (see Fig.245b) has a cut dividing it in two parts. The thin lower part serves as a spring. It can be slightly bent with a screwdriver so that the pawl tooth shifts toward the gear *2* (Fig.245a). If a tooth is missing, the pawl must be replaced.

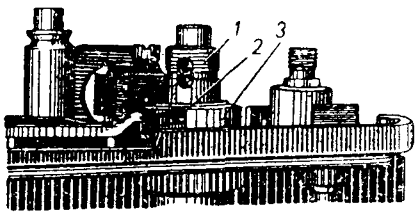


Figure 246. The upper parts of the disengagement mechanism.

Incorrect camera disassembly may result in a spring lever *5* (Fig.245b) deformation. That is why it requires very gentle handling. The lever must be in the shape of a circle with a somewhat smaller diameter than the slot in the shaft which bears it.

Film Rewind Disengagement Mechanism

The disengagement mechanism releases the transport sprocket engaged with the other gears when the film is being rewound. This part is more reliable in the FED-2 camera (Figures 246, 247, and 248) than in FED.

The FED transport sprocket is turned by the gear connected with the winding mechanism. The transport sprocket pin advances the focal plane shutter. The disengagement mechanism simultaneously unlinks the gear and the pin. The same happens in the FED-2 camera, the only difference being in the disengagement mechanism's design.

In the FED-2 camera, disengagement is done by a cap with a release button inside it. The cap is screwed on the moving bushing *1* (Fig.246) which can go down while being turned by the guiding screw *2*. The latter moves in the beveled groove of the fixed bushing *3* secured on the body. In the process of lowering, the bushing disengages the pins *2* and *3* (Fig.247) and the release gear pin *3* with the aid of the rod. Simultaneously it separates the two bushings inside the transport sprocket, one of which has two pins and the other has two slots.

The bushing *3* (Fig.248) is secured on the gear *4*. The second moving bushing *2* is located inside the sprocket and is driven by the spiral spring *1*. When the bushing *1* (Fig.246) shifts, it pushes out the moving bushing *2* (Fig.248) with the aid of the bushing (tube) and disengages the bushings *2* and *3*. In doing this, it disengages the transport sprocket from the gears of the mechanism.

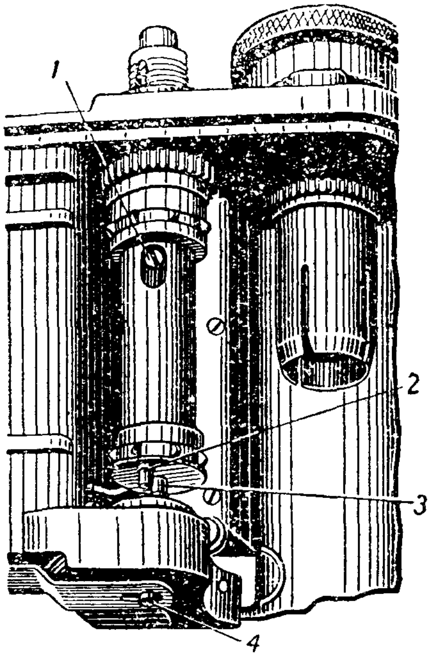


Figure 247. The transport sprocket disengagement mechanism.

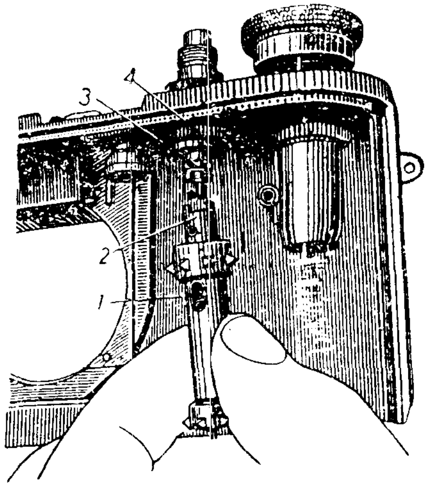


Figure 248. The parts positioned inside the transport sprocket.

Disengagement mechanism malfunctions. ***The switch cap does not lower when it turns, and its rotation is not restricted.*** This occurs when the guiding screw *2* (Fig.246) falls out. Lift the cap and remove it along with the bushing *1*. If you shake the camera lightly, you will hear the sound of the loose screw hitting against the top plate *6* (Fig.241). To correct the problem, remove the top plate, find the screw and put it back in place. An explanation on how to remove the plate is given below.

Apart from this disengagement mechanism malfunction, other problems may arise, such as the worn out bushing *3* slots (Fig.248) or the screw *1* (Fig.247) falling out. But they have more to do with the operation of the focal plane shutter and are discussed in other sections of the book.

Partial and Complete Camera Disassemby and Reassembly

Partial FED-2 camera disassembly consists in removing the top plate. The shutter mechanism is separated from the body only for the purpose of complete disassembly. To remove the top plate *6* (Fig.241), unscrew three or five facing screws (depending on the modification); unscrew three screws and remove the accessory shoe; unscrew the exterior rim of the optical wedge *4*; take off the optical wedge in the mount *3* and the eyepiece *6* (Fig.249); unscrew the set screws and remove the shutter speed mechanism knob *5* (Fig.241); free the set screw and remove the cap of the film rewind switch *7* after unscrewing one screw on the knob's shaft; free the set screw, remove the winding knob *2* and the counter dial *1*. The dial is fitted on the brass bushing. If there are washers between the dial and the bushing they have to be saved for reassembly. In the models with three facing screws, the fourth (fastening) screw is located under the counter dial *1*.

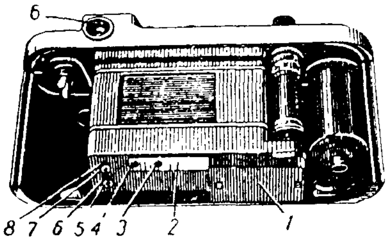


Figure 249. The exterior parts of the focal plane shutter.

When removing the top plate, note the dioptre sight correction handle *8*. It comes off with the top plate and they are reinstalled together. However, the dioptre sight correction handle is hard to reinstall. To do that, slightly move aside the frame lever *2* (see Fig.265) by running a piece of bent wire through the hole for the eyepiece *6* (Fig.249). This can sometimes be done with a thin screwdriver. The spiral spring under the handle *8* (Fig.241) has to be removed to avoid loosing it when the top plate is being taken out and then reinstalled. The later modification of the FED-2 camera does not have the lever *2* (see Fig.265). Its work is done by the cut end of the spiral spring discussed above.

Reassembling is done in the reverse order.

Complete disassembly is done as follows. Having removed the top plate *6* (Fig.241), reinstall the counter dial and the winding knob *2* because any repair requires winding the shutter and checking its operation.

Next free the spring *5* (Fig.250) and remove the pawl *4*; unscrew the pointer *3* and remove the exposure lever *2*. (The pointer has a through hole for a tool and should not be unscrewed with pliers.) Then unscrew a screw and remove the exposure disk *1*. If there is a shield *1* (Fig.249), it should also be removed. After you have unscrewed the screws *3* and *4*, remove the flat spring *2*, as well as the lath supporting the screws *3* and *4* and the angle piece located inside the shutter body. Having removed the set screws *6* and *8*, release the springs of the focal plane shutter bushing sleeves and unscrew the shaped nuts *5* and *7* with the left hand threads.

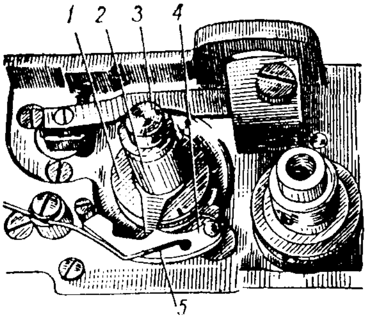


Figure 250. The shutter speed mechanism.

If the camera has a flash synchronization device, unscrew the screws *6* and *7* (see Fig.255) and free the contact with the washer *4*. Then unscrew the top screws *11* and *12* (see Fig.265) fastening the top of the shutter body and unscrew the four screws on the front of the camera body. Carefully remove the body with the focal plane shutter (see Fig.251) to prevent the shaft from falling out of the socket in the base of the shutter body. Otherwise the gears *1* and *2* will become disengaged. You should also make sure that the pulley *7* does not fall out and get lost.

It is not always necessary to disassemble the shutter mechanism (Fig.251) for repair. If it is not required, remove the body with the shutter without disassembling it. In that case, do not unscrew the screws *6* and *8* (Fig.249) and do not release the springs.

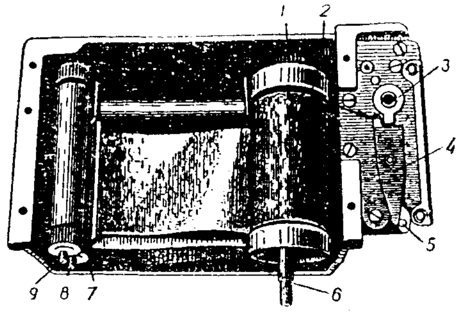


Figure 251. The shutter and the front of the selftimer mechanism.

The shutter mechanism in the FED-2 camera is designed and disassembled the same way as in the FED camera (see p.115). The reassembly is also done similarly, except that in the FED-2 camera the mechanism is attached to the assembly plate somewhat differently. In FED, the springs in the bushing sleeves are wound after connecting the shutter and the assembly plate. In the FED-2 camera it is just opposite: the springs are first wound (if they had been unwound for repair) and then the shutter and the assembly plate are connected (which is more convenient). Besides, the FED camera drum has holes of three kinds (see Figures 133 and 134), whereas the FED-2 drum always has just one kind (see Fig.134a). The FED-2 camera shutter is assembled as shown in Figure 133, i.e., the hole in the drum is positioned over the pulley segment (see upper arrow in Fig.133), the springs in the bushing sleeves are wound by turning them 3.5-4 times counter-clockwise, and the screws *6* and *8* (Fig.249) are tightened. Then, having set the coupling with the pin 1 in a correct position, hold the shutter body in your left hand and the shutter with the body in your right hand and connect them. The drum and both pulleys should be set as shown in Figure 133. (The Figure shows the positions of the parts with the shutter wound.) Then release the drum and the pulleys, so that the

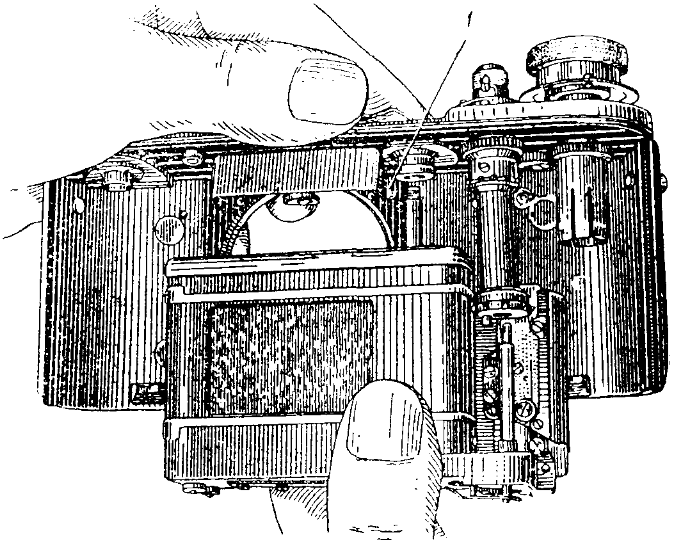


Figure 252. The shutter assembly.

wound springs drive them to their starting positions. You can then connect the shutter with the assembly plate. The hole in the drum marked with an arrow in Figure 133 should be set in front of the pulley segment.

When connecting the parts, make sure that the pin *1* (see Fig.252) enters the curtain's drum hole, and the shaft *6* (see Fig.251) gets in the hole of the coupling. This is the most difficult step in the reassembly. If it so happens that after the reassembling the winding of the shutter winds only one curtain, it means that the pin *1* (see Fig.252) did enter the drum hole, but the hole was positioned behind the pulley segment and not in front of it. In this case you will have to repeat the assembling.

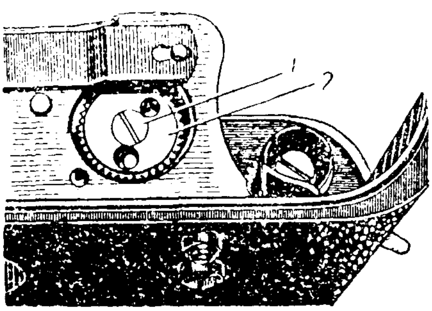


Figure 253. The restrictive gear.

After the parts are connected, tighten the screw *11* (see Fig.265) and put the shafts *8* and *9* (Fig.251) in the sockets. This, too, is not easy to achieve after one attempt. First, try to install the bushing sleeves and shafts in place with your hand or using a tool. If you do not succeed, insert a screwdriver in the slots and slightly move the opposite sides of the shafts until they set in place.

Then tighten the screw *12* (Fig.265) and the four screws on the front of the camera body.

One of the features of the FED-2 camera that gives it an advantage over other cameras with focal plane shutters is a free access to the restrictive gear *2* (Fig.253). It is very convenient for camera assembling and repair. In the FED camera, the restrictive gear *1* (see Fig.128) is hidden inside the body, and to install the gears *6* and *8* (see Fig.127) correctly, assembling has to be repeated many times (see p.117). In the FED-2 camera, the gears *1* and *2* (Fig.251) may be installed approximately. At a later point, when the mechanism is assembled, the gear *2* (Fig.253) has to be set so as to position the cam *7* (Fig.126) in the wound shutter approximately in the center of the recess in the lever *5*.

All adjustments of the curtains and shutter speeds are done the same way as in the FED camera.

Note one more advantage of the FED-2 camera: complete disassembling does not require removing the lens mount ring *7* (Fig.256) which may cause lens misadjustment.

Shutter Speed Mechanism

The FED-2 camera's shutter speed mechanism is primarily the same as in FED with the exception of the shutter speed knob that was changed in later modifications of the FED-2 camera. First models had marks on the speed knob opposite the arrow on the top plate *6* (Fig.241). Later models have a dot on the pointer *3* (Fig.250) instead of the arrow.

In the first models, the exposure lever *2* was fastened with a regular screw and had the speed knob on top. In later modifications the pointer *3* ran inside the hole in the speed knob. The pointer is fixed, and the knob turns with respect to the screw when the speed is set. If the screw is loose, it is impossible to set the required shutter speed. For repair, remove the speed knob fastened with two set screws. The pointer has a hole for a tool. There is a spiral spring under it, and the spring may push the pointer out. This is why the pointer should be held down while being unscrewed. Having tightened the pointer, install the speed knob again. To install it correctly, watch the operation of the shutter (it is seen when the cover is open) and set the "B" speed.

Focal Plane Shutter

The FED-2 camera focal plane shutter is basically the same as in the FED camera with the exception of its method of disassembling and reassembling described above. One of the advantages of the FED-2 camera is the fact that its removable back cover allows speed adjustments without removing the mechanism from the body.

In general the malfunctions and repair of the FED-2 camera are the same as in the FED camera, but it may also have some problems of its own.

1. ***The screw 1 (Fig.253) fastening the gear 2 becomes loose.*** The gear *2* rotates in both directions. In the FED camera, the screw fastening the restrictive gear is held down by a counter-nut. The FED-2 camera does not have a counter-nut, thus the screw may become loose. In that case the shutter stops functioning, and it is essential to tighten the screw. Correct installation of the gear *2* is described on p.204.

2. ***Skipped frames.*** If this malfunction occurs, you must wind and release the shutter, repeating this several times while watching the pins *2* and *3* (Fig.247) located on the transport sprocket and on the release gear. When the release button is depressed, the shaft *4* with the release gear goes down, i.e., the shutter trips. Then the shaft with the gear driven by the spring *2* (Fig.249) returns to the starting position. The pin *3* (Fig.247) stops in front of the pin *2* of the transport sprocket. The distance between the pins should be approximately 1 mm.

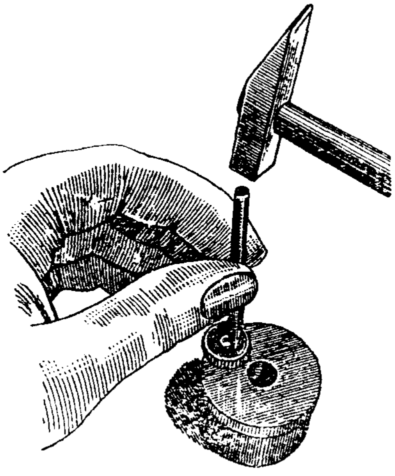


Figure 254. The restrictive gear correction.

Sometimes the gear pin gets on the drum pin (pin over pin). In that case skipping of the next frame occurs. This problem is caused by the restrictive gear *2* (Fig.253) becoming displaced or damaged. Check the fastening of the gear, i.e., whether the screw *1* is tight enough. Even if the screw is untightened by half a turn, the described malfunction will arise. This can be explained as follows. There is a groove on the inner side of the restrictive gear. It holds the pin of the body, thereby limiting the shutter's winding. When the screw *1* is loose, the gear *2* tilts, the pin leaves the groove, and the movement of the shutter parts loses its restriction.

If the screw *1* becomes loose, it can cause more complex problems with the gear *2* itself. The shutter body pin damages the groove sides and increases its size. If this should happen, remove the restrictive gear, put it on a hard surface (Fig.254), and restore the shape of the groove by a stroke of a center punch on the plane at the groove's edge. You can then reinstall the gear (see p.204).

If the screw *1* (Fig.253) is tightened all the way, but the frames are skipped nevertheless, check whether the pins of the transport sprocket are secured well. Cases of pins getting loose are uncommon.

Skipping of frames may be caused by one more reason. After the shutter is released, the release gear returns to its starting position driven by the spring *2* (Fig.249). If the spring is weak, the gear and, therefore, its pin do not return to the starting position. This defect can be indicated by the release button not returning upward or returning too slowly. To strengthen the spring *2*, unscrew the screws *3* and *4* fastening it, bend the spring slightly, and reinstall it. Before removing the spring, memorize the position of the lath holding the spring's fastening screws and the light shield (angle piece) and reinstall it correctly. Make sure that the edges of the light shield do not catch onto the curtain.

3. ***The film does not advance during mechanism winding.*** First of all, check whether the camera is loaded correctly. If it is, remove the cartridge with the film and wind the mechanism, while holding the transport sprocket *1* (Fig.245a) with the thumb of your left hand to imitate the load created by the film. If the sprocket does not turn at all or turns jerkily, check whether the screw *1* (Fig.247) that should be inserted in the hole of the transport sprocket and should connect it with the interior lower coupling *2* (Fig.248) is in place. If it has fallen out, put it back in.

There might be another, more serious reason for this problem. The disengagement mechanism design and the operation of the couplings *2* and *3* (Fig.248) were described on p.203. Sometimes the pins or slots of the couplings wear away and stop functioning. The slots of the brass upper coupling *3* wear out the most. When the lower coupling *2* with the screw *1* (Fig.247) fastened on it goes down when the shutter is wound, you can hear it click. To eliminate the malfunction, disassemble the camera and remove the shutter body. Then, depending on the modification, unscrew one or two screws used to fasten the transport sprocket and remove the sprocket itself. Your next step will be to fix the upper coupling *3* slots (Fig.248) using a flat file. Keep in mind during the reassembling that the lower coupling *2* is under pressure from the spring and may not get in place at once. Therefore, set the transport sprocket with your left hand and slowly wind the mechanism with your right hand.

4. ***When the shutter trips, the second curtain does not return to the starting position.***

Sometimes during the shutter operation, especially at 1/25 and 1/50 sec speeds, the short curtain returns to its starting position, and the long curtain stops approximately in the center of the frame window in the shutter body.

In that case wind the second curtain spring, turning it half way, by untightening the locking screw *6* (Fig.249). Insert the second screwdriver in the shaft slot to prevent the spring from unwinding. Next, wind the spring half way counter-clockwise.

After the problem is corrected, adjust the speeds as described on p.120.

5. ***The speeds do not work.*** This defect is manifested as follows. At the shutter release, instead of hearing the curtains' double stroke, one sharp stroke can be heard, which is the same for different speeds. To find the source of the problem, wind the shutter, set it at the "B" speed and push the release button. If the "B" speed is functioning properly, the first curtain returns to its starting position, and the second one remains still when the release button is depressed. In the event of the malfunction being discussed, both curtains return to the starting position simultaneously. This malfunction is immediately reflected on the developed film: the shutter trips in the same way at all the speeds, and one part of the frame is exposed more than the other. This problem usually occurs when the camera falls or experiences a shock resulting in the lever - catch *4* (Fig.250) falling out. As shown in Figure 250, the lever - catch rests against a screw and is pressed to it by a spring. When lever-catch falls out, it gets on the other side of the screw. After removing the top plate *6* (Fig.241), set the lever-catch as shown in Figure 250. The lever-catch operational principle is discussed in greater detail on p.114 in describing the FED camera.

6. ***The ribbon becomes broken.*** In the FED cameras the ribbon is sewn onto the metal curtain laths. In the FED-2 camera it is not sewn, but placed on the lath and glued to it. If the ribbon breaks close to the lath, you should disassemble the shutter completely and reattach the ribbon. To do that, unbend the end of the lath with a screwdriver, insert the ribbon and squeeze its end. The other end of the ribbon is glued to the bushing sleeve or pulley. When the broken ribbon is reattached to the lath, the ribbon becomes a little shorter as compared to the second whole ribbon. Therefore, the glued end of the second ribbon should be detached and reglued to make both ribbons the same length.

The entire process of disassembling, reassembling and adjustment of the shutter is described on p.117.

Flash Synchronization Mechanism

Most of the FED-2 cameras are equipped with a flash synchronization mechanism.

The pulsed flash can be used only with the 1/25 sec speed because the width of the slit between the curtains is equal to the width of the frame window. The later versions of this camera have more speeds and lack the 1/25 sec speed in accordance with a new federal standard. In these cameras, the pulsed flash can be used with the 1/30 sec speed, whereas the disposable bulbs can be used with the "B" speed.

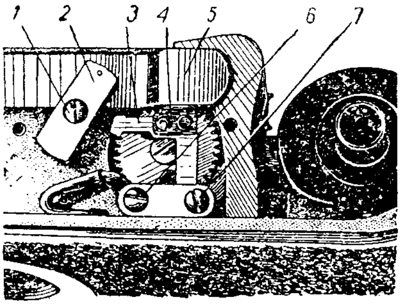


Figure 255. The flash synchronization mechanism of the old design.

There are two kinds of flash synchronization mechanisms.

The earlier camera models have a contact mechanism located on the shutter body (see Fig.259) and a flash socket on the left side of the camera body. The flash socket is connected with the contact mechanism by a thin electric wire.

The contact mechanism has a very simple design and is reliable in operation. It consists of the contact *3* (Fig.255), two insulating washers over the contact base, contact fastening screws *6* and *7* with chlorovinyl insulating tubing on them, and contact disk *2* or plate (depending on the modification).

The contact *3* is insulated from the body. There is an insulating washer *4* on its end which is located under the release spring *5*. The top of the flash synchronization mechanism is covered with the shield *1* (Fig.249) which is fastened with two screws.

At the moment of shooting, when the release button is pushed, the spring *5* (Fig.255) goes down along with the contact *3*. At the same time the focal plane shutter trips. The first curtain returns to its starting position, reels around the bushing sleeve, and its ribbons rotate the pulleys. They turn along with the shaft that bears the disk *2* on its end. The disk is set in a way that when the first curtain completely opens the frame window, the contact on the disk reaches the contact and closes the electric circuit.

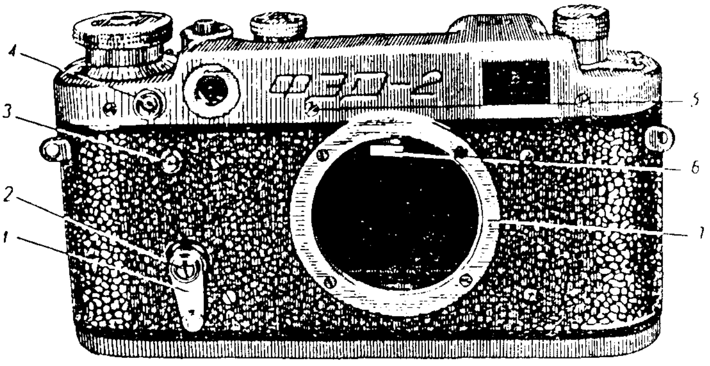


Figure 256. The front of the camera with the selftimer.

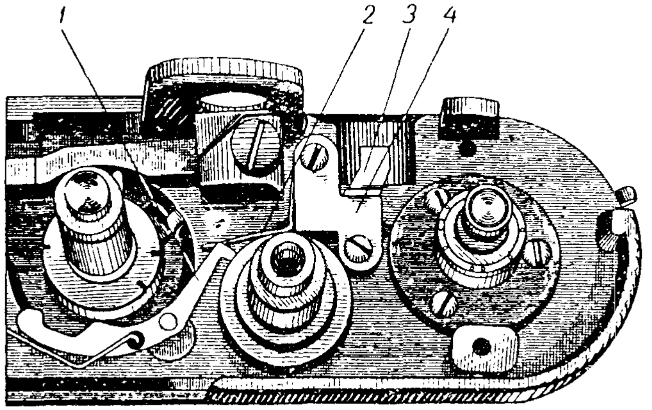


Figure 257. The flash synchronization mechanism of a later design.

Within the next moment, the release button *5* returns to its starting position, presses the washer *4*, shifts out the contact, and breaks the electric circuit. Unlike other cameras, the FED-2 camera has an electric circuit that is always open and closes only at the moment of shooting.

If the pulsed flash does not go off when the shutter is in full operation, the electric circuit is broken or open. The electric circuit breaks when the insulating washers poorly insulate the contact *3* from the body, or when the flash plug is loose in the flash socket on the camera.

The circuit may remain open because the contact on the disk *2* does not reach the contact. In this case, bend the contact or unscrew the screw *1* fastening the disk and set it in the correct position.

In the FED-2 cameras manufactured after 1958, the flash synchronization mechanism design is entirely different. The new flash synchronization device has a much simpler design and is more reliable. The flash socket *4* (see Fig.256) in its later modification is located on the top plate, and the flash synchronization mechanism itself is under the top plate (see Fig.257). The flash synchronization mechanism consists of the spring contact *3*, two getinax insulating washers *4*, and two fastening screws.

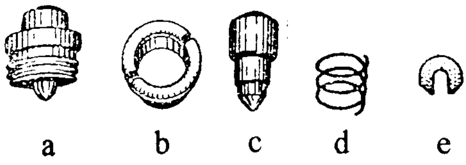


Figure 258. Parts of the release button.

The flash synchronization mechanism's operational principle is as follows: the lever *1* touches the bending *2* of the contact *3* during the operation of the shutter and closes the electric circuit. The next time the shutter winds, the electric circuit does not open because the lever runs above the contact bending.

If the electric circuit does not close, look for the problem in the operation of the lever *1*. To do that, remove the top plate *6* (Fig.241). The flash socket is directly connected with the contact mechanism, i.e., the flash socket middle contact is connected with the spring contact *3*.

Selftimer

The latest models of the FED-2 cameras are equipped with a selftimer mechanism. Its design principle and possible malfunctions are discussed in detail on p.149. The release button (see Fig.258) is the same on all FED-2 cameras. The selftimer malfunctions related to its adjustment are easily corrected because the back of the selftimer mechanism (see Fig.259) can be seen when the back cover is removed. Complex selftimer repair in the FED-2 camera (repair that requires removing the selftimer from the camera) is much more difficult than, for example, in "Zorki-4" because the camera has to be almost completely disassembled before the selftimer can be extracted. You should, therefore, try to do your best to adjust the selftimer without disassembling the camera.

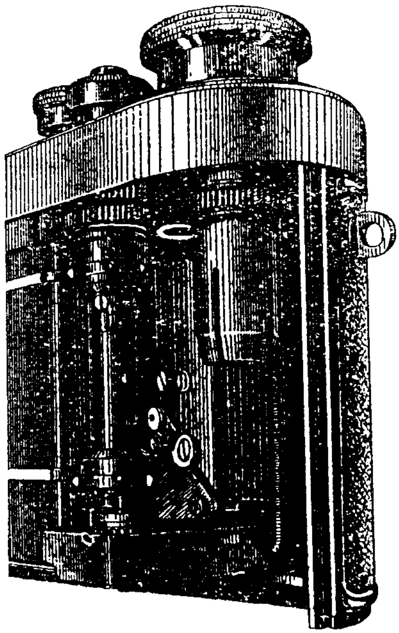


Figure 259. The selftimer mechanism.

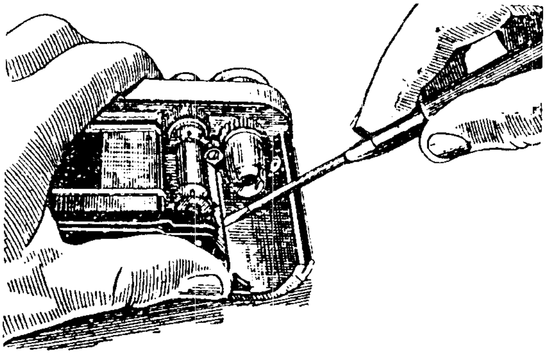


Figure 260. The screwdriver position during the selftimer repair.

For example, to eliminate a jamming of the pin (marked with an arrow in Fig.251) in the camera body, put the end of a screwdriver under the selftimer mechanism (see Fig.260) and slightly lift it in several places. This often corrects the problem.

To remove the selftimer mechanism, disassemble the camera (see p.204) and separate the shutter body (see Fig.251) with the selftimer mechanism secured on it. The selftimer is fastened with three screws. When removing the shutter body, do not change the positions of the gears *1* and *2*. Also do not slacken the springs in the curtain bushing sleeves.

During reassembly, keep in mind that the lever *3* is not fastened and may fall out.

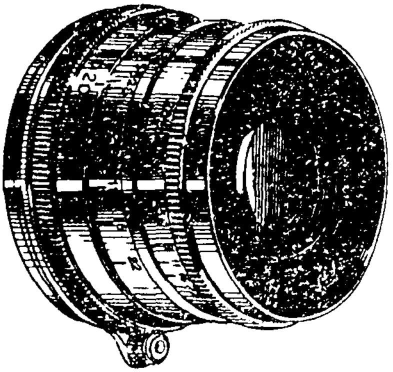


Figure 261. The "Industar-26M" lens.

Lens

All the FED-2 cameras manufactured before 1957 are equipped with the "Industar-10" lens (see p.128), and the cameras made after 1957 have "Industar-26M" (Fig.261). "Industar-26M" is a fast lens with a good resolution. The lens optics are coated, and the mount is rigid. "Industar-26M" is a four-lens semi-glued anastigmatic.

Specifications

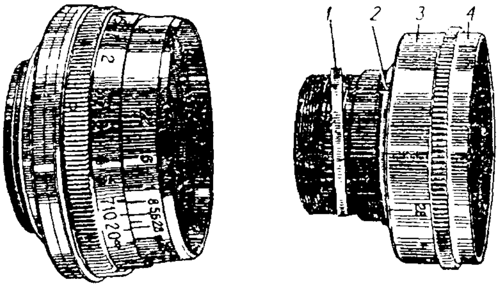
Focal length.....................	50 mm
Relative aperture..............	1:2.8
Field angle.......................	45^0
Relative aperture range.....	2.8; 4; 5.6; 8; 11; 16; 22
Distance scale range..........	from 1 m to ∞
Resolution in lines per 1 mm:	
in field center.......	28
on field edges.......	13

The lens consists of two parts: the system of the lens elements with the diaphragm in the mount (block) *b* (Fig.262) and the exterior mount *a*. The lens system is designed similarly to the one in "Industar-10". There are two front lens elements in front, and the third and fourth are cemented together in back. The diaphragm is located between the second and the third lens elements. The diaphragm tang *3* (Fig.262b) rotates on a thread and is connected with the diaphragm crown (see p.33) by the screw *2* which also restricts diaphragm movement.

The design of the "Industar-26M" lens mount is fairly simple, reliable in operation, and easy to disassemble. The last is very important for repair. Currently the "Jupiter-8" lenses have an identical mount.

Disassembly and adjustment of the lens. To remove the block *b* (Fig.262) from the mount, unscrew the nut *5* (see Fig.264) using a key. In order to prevent the nut from getting loose, nitro-varnish is injected in the thread. You should, therefore, put a drop of acetone on the thread before unscrewing the nut and wait for a while.

In the first modifications of the lens, the block was fastened with the nut *5* alone. This often resulted in the displacement of the block. Later the block was manufactured with a fastening nut and a set screw. This screw may have different locations. Most often it is positioned on the barrel next to the screw *5* (Fig.263) and is covered with oil. Sometimes the set screw is on the ring of the definition depth scale *6*. This ring is fastened on the barrel with three set screws. The longest of these screws runs through the barrel and holds the block.



a b

Figure 262. The disassembled "Industar-26M" lens.

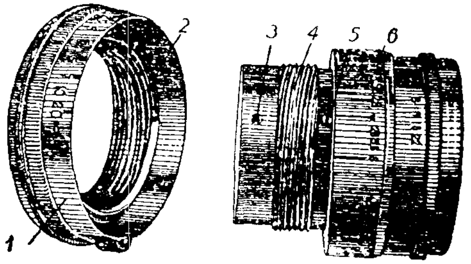


Figure 263. The mount base and lens barrel.

The lens block is removed for diaphragm repair, disassembly of the lens elements, and adjustment of the lens working distance. The adjustment is accomplished using the rings *1* (Fig.262b). The correct working distance is set by changing the rings with different thickness. The lens working distance is measured with the aid of special tools (see p.131).

To remove the front lens element, remove the block, unscrew the screw *2*, and remove the tang *3*. Now free the two set screws and remove the front mount ring *4*. Only after that has been done, it is possible to unscrew the fastening nut of the front lens element. The third and the fourth lens elements are placed in the mount that is screwed in the back of lens. To unscrew it, no disassembly is required.

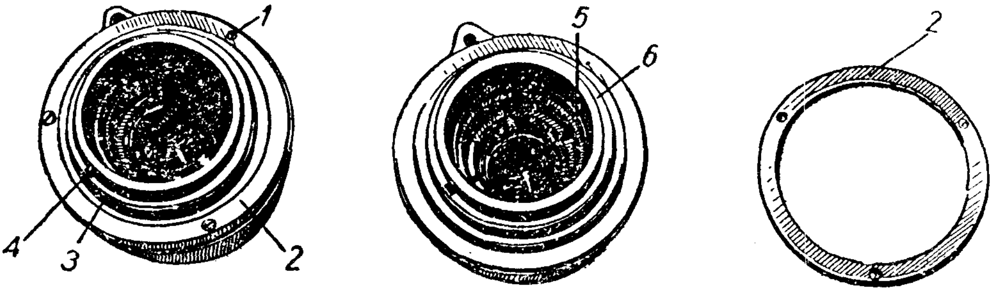


Figure 264. The lens mount parts.

Mount repair does not require removal of the lens block. Mount disassembly is done as follows. Unscrew the three screws *1* (Fig.264), remove the ring *2* and the ring *6* with the groove holding the screw *4*. Having unscrewed the screw *4* (it is screwed in the hole *3*, Fig.263), take out the barrel connected with the mount base by the multi-entry threads *2* and *4*. Unscrew the barrel turning it to the right (the thread goes to the left).

The reassembly is done in the reverse order. When reassembling, it is important to find the correct thread entry in order to connect the barrel and the mount base. This is done as follows. Hold the mount base in your left hand with the barrel in your right hand and set it to the position of the red line on the scale *6* (approximately opposite the numbers 1.5-2 m on the mount *1* scale). Then screw the barrel into the mount counter-clockwise. If the mount scale does not reach the index 1 m, you shall have to repeat the assembly. Since the end of 1959, the "Industar-26M" lens has been manufactured with a slightly altered mount. It does not have a handle, and the mount is corrugated (see Fig.266). This was done to increase the durability of the multi-entry threads.

Lens malfunctions. 1. ***The diaphragm tang is displaced.*** If the lens block with the diaphragm is fastened to the exterior mount with the nut *5* (Fig.264) only, the diaphragm tang *3* (Fig.262b) may become displaced. It shifts when excessive force is applied while tightening or loosening a filter. In this case, hold the lens by the mount in one hand with the diaphragm tang in the other, and put the diaphragm back in place with some force. Also check whether the nut *5* (Fig.264) is tightened.

2. ***The diaphragm tang 3 (Fig.262b) turns, but the diaphragm blades do not move.***

Check whether the screw *2* which connects the tang and the diaphragm crown is in place.

3. ***The lens mount turns with difficulty.*** Sometimes the thickened lubricant makes it hard to turn the lens mount, and it is difficult to focus by the rangefinder. Change the lubricant on the rubbing surfaces of the mount parts. To do that, remove the ring *2* (Fig.264) along with the ring *6*, and unscrew the base of the mount *1* (Fig.263). Soak all the removed parts in benzine and wash off the old lubricant. The lubricant from the multi-entry threads *2* and *4* should be removed with a benzine moistened piece of cotton. Now the multi-entry threads, the guiding screw *4* (Fig.264), and the rubbing surfaces of the rings *6* and *2* have to be lubricated with thick watch oil.

Details on mount disassembly and reassembly were discussed above.

4. ***Mount backlash.*** Check the screw *4* (Fig.264). If it is not tightened all the way, remove the rings *2* and *6*, and tighten it.

Viewfinder-Rangefinder

The FED-2 camera optical rangefinder is combined with the optical viewfinder in a single field of view. Such a design of the viewfinder-rangefinder makes shooting easier and faster, warrants precise lens focusing and ensures better choice of the frame borders at the moment of shooting.

The viewfinder-rangefinder consists of the eyepiece *6* (Fig.249), and the block of prisms *3* glued together (Fig.265). The prisms are joined together at an angle of 45° to the eye line. The adhesive joint, coated with a beam-splitting layer, is indicated with a dotted line on Fig.265. The prism block is fitted by means of the washer and two screws; prism lever *8* with the three-edged prism *9* secured on it; ledged screw *10* with the lever connected to the prism *9* turning around it; cam *5* and the lever with the rangefinder cam *6* (Fig.256) secured on its bottom; and diaphragm *4* (Fig.265).

The design principle and the operation of the FED-2 camera rangefinder are the same as those of the FED camera and are discussed in detail on p.134. The FED-2 rangefinder malfunctions can usually be eliminated without partial camera disassembly. The vertical adjustment is done with the optical wedge *3* (Fig.241). To do that, unscrew the optical wedge rim *4* and match the still and moving object images vertically by slightly turning the mount and the optical wedge in both directions.

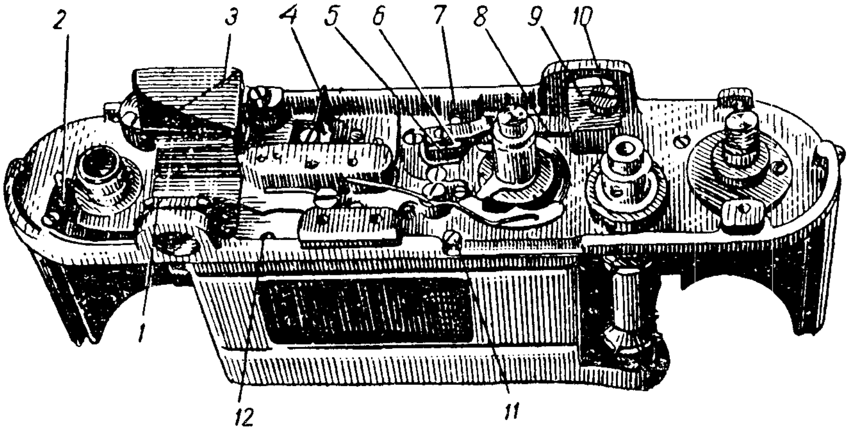


Figure 265. The assembling panel of the camera with the viewfinder-rangefinder.

If the vertical adjustment cannot be done by this method, remove the top plate *6* (Fig.241), reinstall the eyepiece *6* (Fig.249), and continue the adjustment with the help of the block of glued prisms *3* (Fig.265). The prism block is fastened with the washer and two screws. Free the screws and put a thin cardboard shim underneath the prism. As a rule the adjustment will be achieved if you untighten one of the prism fastening screws by half a turn and tighten the other screw in exactly the same way.

When removing the top plate, you should check whether the screw *10* (Fig.265) is tightened all the way.

The horizontal adjustment is controlled with the screw *6*. The screw 6 is screwed in the prism lever *8* hole; its end is pressed by the spring *7* against the cam *5*. For adjustment, unscrew the screw *5* (Fig.256) and insert a thin screwdriver in the hole for this screw. Find the screw *6* slot (Fig.265) and turn it slightly in either direction. When doing that, focus the camera on an infinitely distant object. If the second (moving) image of the infinitely distant object stops short of the directly viewed image, the screw *6* should be tightened; if it goes too far, the screw has to be loosened. The horizontal adjustment can also be controlled with the rangefinder cam *6* (Fig.256); details of the adjustment can be found on p.135.

An orange circle is visible against the rectangular blue background of the viewfinder-rangefinder. Its shape can be adjusted with the diaphragm *4* (Fig.265) fastened with one screw. Having untightened the screw by turning it half way, shift the diaphragm.

It is not recommended to unscrew the screw *10* of the prism lever fastening.

The later modifications of the FED-2 camera do not have the lever *2* (Fig.265). Instead, a tail is attached to the lever *8* (Fig.241) and shifts the frame *1* (Fig.265).

When removing the top plate *6* (Fig.241), note the position of the spring under the lever *8* to be able to reinstall it correctly.

"ZARYA"

The "Zarya" camera was made on the basis of the last FED-2 camera modification. It was given a somewhat simplified design for easier camera operation and increased shooting speed.

All the parts and mechanisms of the "Zarya" camera are the same as corresponding ones in the FED-2 camera. Their design and repair are discussed in detail in the FED-2 camera description.

The "Zarya" camera does not have a rangefinder because a non-professional takes most of his shots from a distance of over 3 m and at a 5.6-8 relative aperture. With these shooting conditions there is no need for precise rangefinder focusing due to the depth of field of the lens. Instead, the lens can be set by using the range scale and guessing the distance.

The camera's viewfinder gives a good view of the object, almost in actual size.

The absence of the rangefinder allowed to change the configuration of the top plate and to decrease the camera size. Due to that the sequence of partial camera disassembly, described below, was slightly changed.

Major Exterior Camera Assemblies and Parts

The camera consists of the body *1* (Fig.266), flash socket *2*, exposure counter dial *3*, winding knob *4*, film type index 5, mechanism switch bushing 6, release button *7*, shutter speed mechanism knob *8*, accessory shoe *9*, top plate *10*, viewfinder lens *11*, film wind knob *12*, lens *13*, and back cover *14*.

Camera Disassembly

The top plate *10* (Fig.266) is removed as follows. Unscrew the three facing screws (two in front and one in the back); free the set screws and remove the switch bushing *6*; free the set screws and remove the shutter speed mechanism knob *8*; unscrew the film wind knob *12* while holding the tang fork with pliers; free the set screw and remove the winding knob *4*, the spring

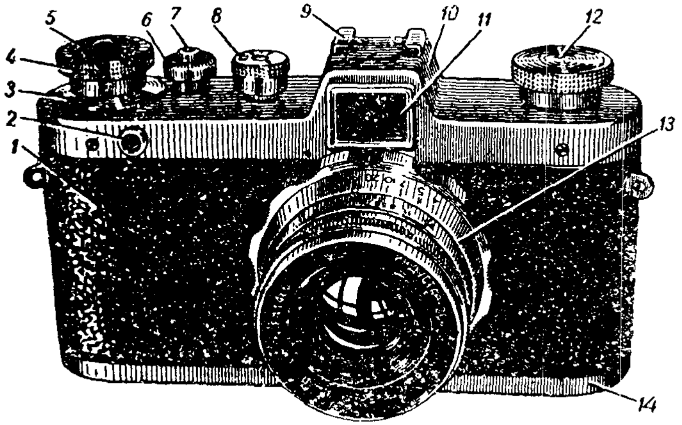


Figure 266. The "Zarya" camera.

washer, the exposure counter dial, and the shim; unscrew the screw under the exposure counter dial.

It is not necessary to remove the accessory shoe *9* and the viewfinder eyepiece because the accessory shoe is fastened not to the body as in the FED-2 camera, but to the top plate itself and the eyepiece is fixed. The viewfinder is fixed on the top plate as well, fastened with the same screws which hold the accessory shoe *9*. The viewfinder itself consists of the frame holding the viewfinder lens element *11*, and the eyepiece. The lens element is glued with shellac. For further disassembly, follow the same steps as those suggested for the FED-2 camera (see p.204).

FED-3

The FED-3 camera (Fig.267) is an improved modification of the FED-2 camera. Providing the camera with an additional shutter speed mechanism changed shape of the top plate. Besides, the rangefinder and the dioptre sight correction mechanism in the FED-3 camera have a better design. FED-3 also has a shock absorber for decreasing the first curtain's impact.

All the other parts and assemblies are the same as in the FED-2 camera. Changes and additions to the camera design are described below.

Camera Disassembly

To remove the top plate *4* (Fig.268), turn the dioptre sight correction mechanism knob *1* clockwise all the way and remove it after unscrewing the two set screws. Usually there is a spring washer under the knob that should also be removed. The washer is set on the moving dioptre sight correction bushing. In some cameras this washer is set on the bushing outside the top plate.

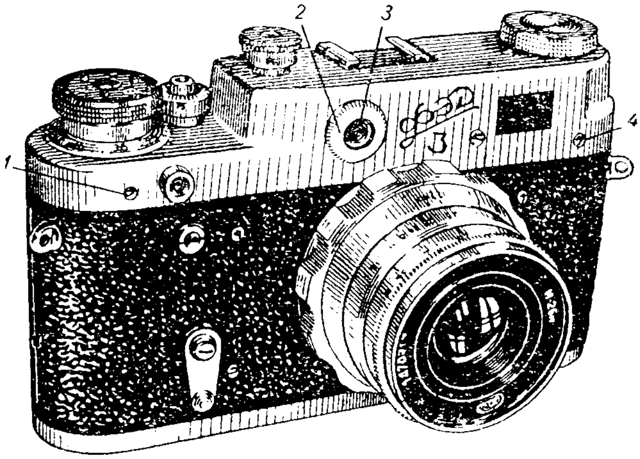


Figure 267. The FED-3 camera.

Memorize the position of the washer and put it back when reassembling the camera. Turn the bushing clockwise all the way so it does not interfere with removing the top plate. Then unscrew the two set screws and remove the shutter speed mechanism knob *5*; unscrew the set screw and the winding knob *7*; remove the spring washer, the counter dial *8*, and the bushing with the counter dial, all of which are located under the knob. There may be one or two washers between the dial and bushing, and their positions ought to be memorized. Then unscrew the

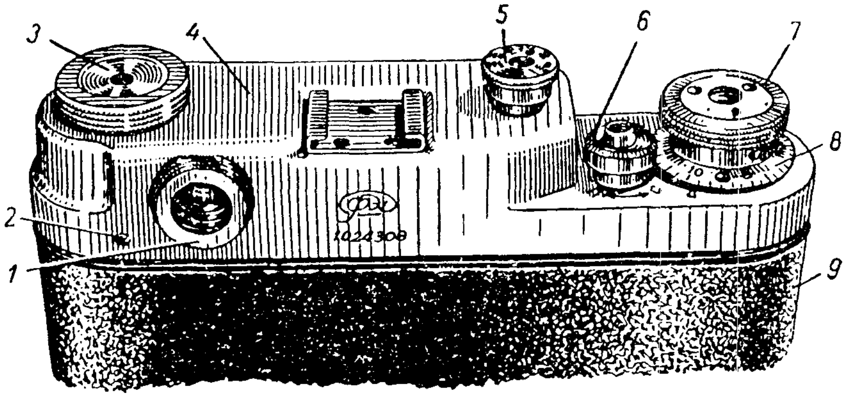


Figure 268. The top plate and the eyepiece.

set screw and the switch mechanism tang *6*; unscrew the optical wedge rim *2* (Fig.267) and the mount *3* with the optical wedge; unscrew the facing screws *1* and *4*, unscrew the screw *2* (Fig.268); unscrew the screw located under the exposure counter dial. Then remove the plate *9*, hold the rewinding fork with pliers and unscrew the knob *3*. After that remove the top plate.

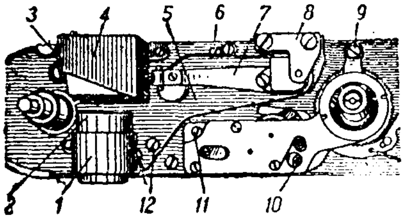


Figure 269. The camera assembly plate.

The additional shutter speed delay mechanism is fastened with the screws *9*, *10*, and *11* (Fig.269). The viewfinder-rangefinder is assembled on the base 5 that is fastened with the screws *3*, *6*, and *12* to the top assembly panel.

Further disassembly is done the same way as in the FED-2 camera (see p.204). When doing complete camera disassembling, do not remove the base *1* (Fig.270).

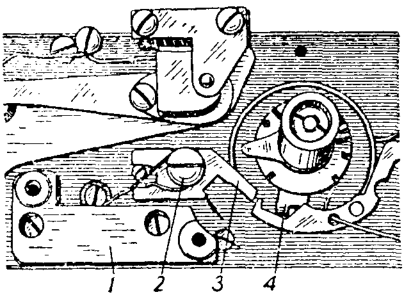


Figure 270. The delay mechanism base.

Additional Shutter Speed Mechanism

The design of the mechanism for the 1, 1/2, 1/4, 1/8, 1/15 sec speeds is for the most part identical to the "Zorki-4" camera mechanism design (see p.174). However, in the FED-3 camera the delay mechanism is fastened with three, not two screws. The third screw *9* (Fig.269) holds a dove-tail for preventing the Malfunction 1 described on p.178.

In earlier models of the FED-3 camera, the slide-catch *10* (see Fig.214a) was the same as in the "Zorki-4" camera; later its design was improved. The later version of the slide-catch *3* (Fig.270) is under pressure from a spring and turns around a shaft which is the ledged screw *2*.

The newer modification of the slide-catch functions the same way as the old one. Its arm halts the movement of the coupling cam *4* and the second curtain until the delay mechanism has tripped and the cam *4* (see Fig.215) has shifted the slide-catch *3* (Fig.270) to the side. The cam hits the protruding part of the lever *3* (see arrow).

All the malfunctions of the additional shutter speed mechanism in the "Zorki-4" camera and their elimination are exactly identical to the FED-3 camera.

Viewfinder-Rangefinder and Dioptre Sight Correction Mechanism

There is no major difference between the viewfinder-rangefinders in the FED-3 and FED-2 cameras. However, a number of improvements warrant better operation of the FED-3 mechanism. The prism lever *7* (Fig.269) turns with the aid of two metal balls, one of them positioned under the lever, and the other above it under the washer *8*.

The block of prisms *4* glued together is attached to the base with glue and fastened with a washer. It is not advisable to remove the prism block. The FED-3 camera does not have a removable viewfinder eyepiece. The viewfinder lens element is secured in the moving bushing *1* (Fig.269). There is another bushing inside this bushing that holds the dioptre sight correction lens element. Both bushings are located and move inside the bushing sleeve *2* with the aid of a beveled groove on the bushing *1* and guiding screw (see arrow).

Malfunctions occur less frequently in the FED-3 camera rangefinder than in the FED-2 camera, while rangefinder adjustment is identical (see p.214). If you happen to drop the camera, the prism lever *7* may fall out. The cam *6* (Fig.256) then lowers inside the camera, and the coupling of the lens and rangefinder becomes misadjusted. Remove the top plate, find the ball if it has fallen out and put it in place. (More often than not, the missing element is the ball.) To find the ball, unscrew the first screw fastening the washer *8*, slightly shift the washer aside, put the ball back in, and reinstall the washer.

"ZENIT", "ZENIT-C", "ZENIT-3", "CRYSTAL", AND "ZENIT-3M" CAMERAS

This group includes single lens reflex cameras manufactured on the basis of the "Zorki" camera.

It is recommended that you become familiar with the FED and "Zorki" cameras before moving on to cameras of this group.

The "Zenit", "Zenit-C", and "Zenit-3" cameras are joined in one group not only because they are all single lens reflex cameras, but also because the design of their major parts is absolutely identical. For example, the "Zenit-C" camera differs from the "Zenit" camera only in that it has a flash synchronization device and an improved mirror drive mechanism. The "Zenit-3" has a lever to wind the mechanism and a selftimer.

Although the "Crystal" and "Zenit-3M" cameras belong to this same group, they are significantly different from "Zenit", "Zenit-C", and "Zenit-3" since they have a hinged cover which altered the design of the body and shutter, and changed the camera disassembly and reassembly method. These cameras also have a different mirror drive mechanism and shutter winding mechanism. Only the optical diagrams of their viewfinders are the same.

"ZENIT"

In the "Zenit" camera, the focal plane shutter, the shutter speed mechanism, and the film transport mechanism are analogous to those in the "Zorki" camera.

Major Exterior Camera Assemblies and Parts

The camera consists of the body *1* (Fig.271), winding knob *2*, exposure counter *3* , release button rim *4*, release button *5*, mechanism switch handle *6*, top plate *7*, film wind mechanism knob *8*, assembly plate *9*, lens *10*, and base plate *11*.

Partial and Complete Disassembly and Reassembly

The "Zenit" camera disassembly is basically the same as that of the "Zorki" camera. Partial disassembling implies removing the top plate and removing the mechanism from the body *1*.

In appearance the "Zenit" camera differs from "Zorki" only in that the pentaprism shield has a rooflike shape, while the front part of the body with the traveling mirror is somewhat protruding.

Remove the mechanism from the body after unscrewing four or two (depending on the modification) facing screws located on the front of the camera body and six screws on the sides of the top assembly plate *9* (one of the screws, the back one to the left, is shorter than the rest). Remove the mechanism gently to avoid damaging the support plate (see p 107).

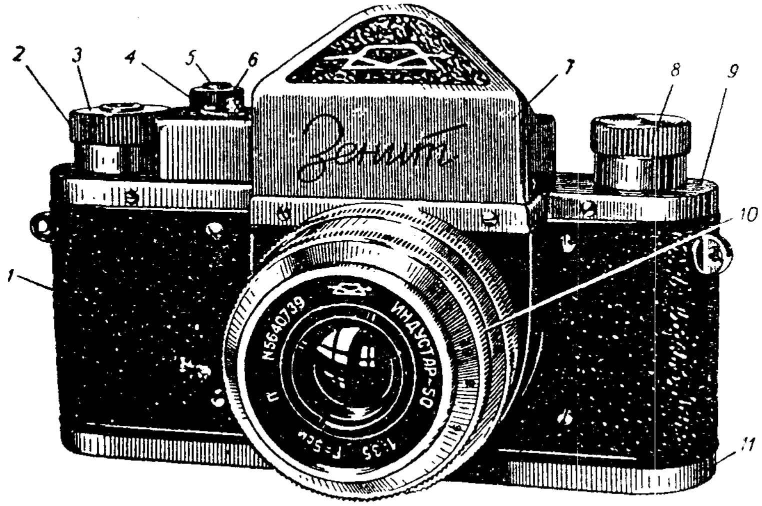


Figure 271. The "Zenit" camera.

To remove the top plate *7*, unscrew four side fastening screws; unscrew the set screws and remove the shutter speed mechanism knob *2* (Fig.272); unscrew the rim *4* (Fig.271) and remove the knob *5*; unscrew a screw and remove the switch handle *6*. (There are always one or two washers underneath the handle, and they should be removed and saved for future reassembly.) Having removed the plate *7*, reinstall the release button *5* to put its pin in the hole in the base, and tighten the rim *4*. This is done to release the shutter during its examining and repair. The body and the top plate are shown in Figure 273.

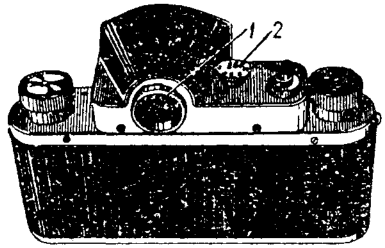


Figure 272. The exterior camera parts.

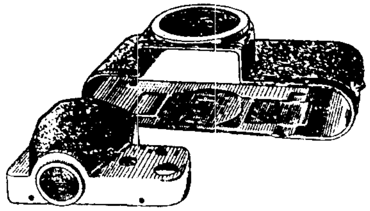


Figure 273. The body and top plate of the camera.

The complete camera disassembly is equivalent to disassembling the shutter that is the same as in the "Zorki" camera. However, the "Zenit" camera has a mirror drive mechanism absent in the "Zorki" camera. The mirror drive mechanism should be disassembled before the shutter. To do that, remove the lever *1* (Fig.278). Its pin enters the hole in the shutter body or (depending on the modification) is attached to the lever *6* (Fig.280) fastened with two screws to the body. The position of the lever *6* is controlled by means of screw holes, the diameters of which is considerably larger than the diameters of the screws themselves. To make reassembling easier, memorize the positions of the screws. (Usually, the paint is worn out in the place of their location.)

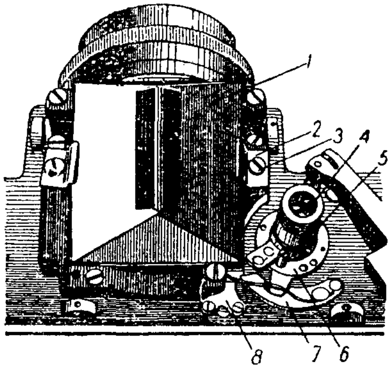


Figure 274. Camera shutter speed mechanism.

The next stage will be to free one end of the springs *2* and *4* (Fig.278) and remove the lever *5* with its pin inserted in the hole in the shutter's body or fastened with a screw (depending on the modification).

You should then disassemble the shutter speed mechanism. To do that, unscrew the screw *4* (Fig.274) and remove the exposure regulator *5*; unscrew a screw and remove the exposure disk *6*.

Disassembling also requires removing the lever catch *7*. However, the shaft of the catch does not come out freely as in the "Zorki" camera. The shaft has a groove holding the ledge of the pulley *5* (see Fig.127). This ledge has a hole in it, and in order to take the catch out, you will have to match this opening with the catch shaft. Wind the shutter slowly, holding the catch in your left hand. When the hole matches the shaft, the catch will come out. To get a clearer picture of this device and reinstall the catch at assembly, unscrew the screw *1* (Fig.280) fastening the spring *7*, untighten the screw *3* turning it half way, and shift the spring *7* until you match the end of the shaft *9* and the wide portion of the hole in the spring. Lift the spring's end to unhook it from the shaft *9* and slightly shift it aside until the hole in the catch shaft comes into view. When you look through the hole you can see that part of it is covered by the pulley's ledge. Wind the shutter slowly, and as the pulley is turned its hole will match the hole in the shutter body. This position allows to reinstall the catch shaft during camera assembly.

To separate the body with the shutter, unscrew three flat-headed screws. Unlike the "Zorki" camera where the screws are put in from the side of the shutter body and threaded holes are located in the assembly plate, the "Zenit" camera has screws put in from the side of the assembly plate and the threaded holes are made in the shutter body. When the top plate *7* (Fig.271) is removed, two out of three screws are well visible; the third screw is covered by the washer *8* (Fig.274) that is fastened with two screws. After you have memorized how it is installed you can proceed with removing the washer. The lever catch *7* rests against the bending in the washer and should be likewise reinstalled.

A detailed description of further shutter disassembly and reassembly can be found in the section about the "Zorki" camera.

Exposure Counter

The "Zenit" camera has an exposure counter of a contemporary design. It is as simple as the "Zorki" camera exposure counter. Similar exposure counters are installed on many different camera models.

The counter basically consists of one part - the dial *3* (Fig.279) fastened with the screw *4*. There is a spring washer underneath the dial which fills the shaft's axial movement space to prevent the dial from shifting arbitrarily. Each shutter winding rotates the counter dial one point short of a full turn.

The only known malfunction of the exposure counter is the arbitrary shifting of the dial *3*. Should this occur, unscrew the screw *4*, remove the disk, and slightly strengthen the spring washer by bending its teeth.

If it becomes necessary to remove the winding knob, do not remove the exposure counter. It is enough to unscrew just one screw located on the knob itself.

Focal Plane Shutter

The design, possible malfunctions, and repair of the focal plane shutter for the "Zenit" camera are all basically the same as for the "Zorki" camera (see p.115). However, some malfunctions are specific only to the "Zenit" camera.

1. ***During the operation of the shutter, the curtain moves slowly and stops before reaching its starting position.*** This problem may be caused by many factors all of which are discussed in the "Zorki" camera shutter description. One of the possible causes of this malfunction in the "Zenit" camera may be that the top protective plate, located above the mirror shaft, slows down the curtain. The mirror *12* (Fig.278) is set in the mount which turns on the shaft. The black leather glued to the mount comes off and bends the shield; the shield slows down the curtain. In this case, put the protective shield back in place and reglue the leather.

2. ***During the operation of the shutter, both curtains stop before reaching their starting positions.*** The reason for this malfunction may be that one of the rods *2* (Fig.275), which both hold the collective lens element *1*, shifts and blocks the curtain's way. The rods are located in the prism base holes and are glued with shellac. If a rod is loose, it shifts out toward the curtains and hinders the curtain's metal lath. To put the rod back in place, remove the top plate *7* (Fig.271) and the pentaprism *1* (Fig.274) fastened with the protective shield *2* and the screws *3*. Disassembling the prism base is not recommended.

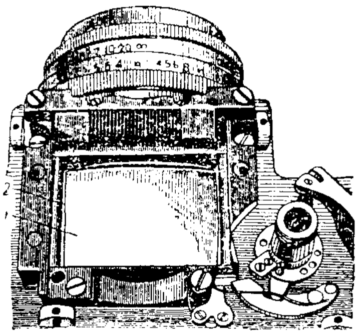


Figure 275. The viewfinder collective lens element.

Focusing and Viewfinding

The mirror finder serves to determine the borders of a frame and to focus.

Viewfinder design. The principal diagram of a viewfinder is shown in Figure 276. The mirror is in the working position *AB* (at a 45° angle to the lens *1* optical axis), and it reflects the image at the ground plane (base plane) of the collective lens element *2*.

The distance between point *O* and the film is equal to the distance between point *O* and the ground plane of the lens element *2*. Therefore, if the image on the ground plane of the lens *2* is sharp, it will be equally sharp on the film as well. (See details in the description of the camera adjustment.) Then the image is reflected by the facets of the rooflike pentaprism *3*, and an erect image appears in the eyepiece *4*.

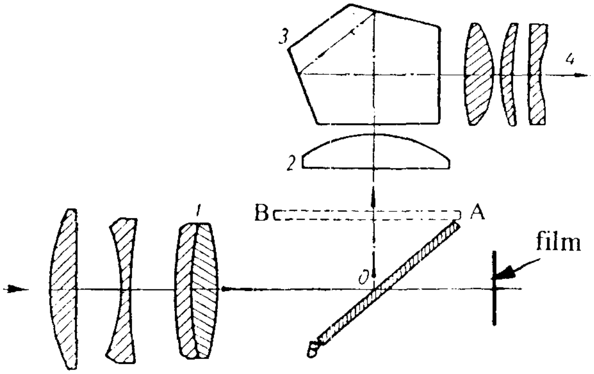


Figure 276. A diagram of the optical viewfinder.

The image in the eyepiece of the "Zenit" camera viewfinder is erect, not mirrored. This is achieved with the aid of the rooflike pentaprism (Fig.277).

The pentaprism is a pentagonal prism with two refracting and two reflecting facets, which turn the image by 90° without mirroring. A pentaprism with a roof where the top reflecting facet is replaced with two perpendicular facets forms not two, but three images and mirrors the image in one plane. In combination with the reflecting mirror, it forms the four reflections necessary for getting an erect image, i.e., one that is not inverted horizontally or vertically. The Figure 277 shows the paths of the beams in a pentaprism with a roof.

The eyepiece *4* (Fig.276) produces 5-fold magnification. The image visible in the eyepiece has 20x28 mm dimensions which make it slightly smaller than the size of a film frame (24x36 mm). This natural phenomenon should not be mistaken for a camera malfunction.

The mirror sets in the *AB* position during the operation of the shutter.

Mirror drive mechanism is one of the most complex and vulnerable in the camera. It consists of the mirror *12* (Fig.278), collective plane-convex lens element (not shown in Fig.278), pentaprism *8*, and eyepiece *1* (Fig.272) secured on the top plate. In addition to these major parts, the mechanism includes the levers *1*, *3*, *5*, and *6* (Fig.278), springs *2* and *4*, lath *11*, lever *13*, lever *1* (Fig.279), bracket *2*, and screw *6*.

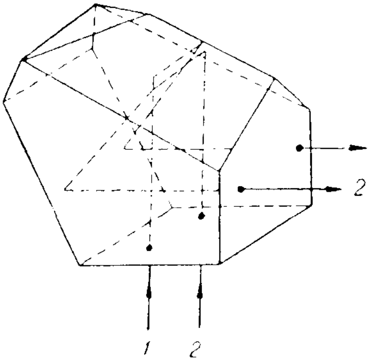


Figure 277. The rooflike pentaprism.

Operation of the mirror drive mechanism. When the focal plane shutter mechanism is being wound, the transport sprocket with the clutch housing the release button *4* (Fig. 271) rotates. The clutch *5* (Fig. 279) makes one full turn during the winding time (Fig.279 shows the release button located on the clutch). The screw *6* is positioned on the clutch. When the clutch rotates, this screw slides along the elliptical surface of the lever *1* and lifts its arm. The lever *1* turns on the bracket *2* shaft and lowers the lever *6* (Fig.278). This lever ensures the movement of the lever *5* which is connected to it. The lever *5* pushes the mirror frame up to the shoulder (see arrow) on the fixating lever *3*. The mirror is now set in the working position (see Fig. 278). The screw *6* (Fig. 279) instantly releases the arm of the lever 1, and all the levers are driven to their starting positions by the spring *4* (Fig. 278). However, the mirror remains in the working position.

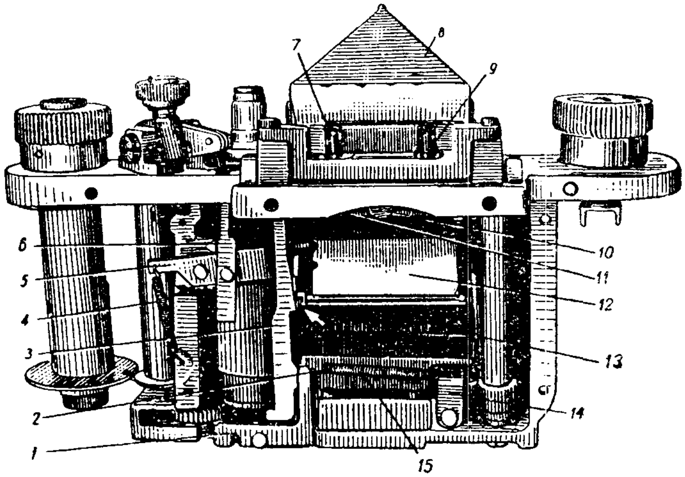


Figure 278. The mirror finder and parts of the mirror drive mechanism.

The mirror is retracted during the operation of the shutter. It has to fall just before the shutter trips, i.e., before the first curtain begins to move. How is this achieved? When the shutter release button is depressed, the flat spring *7* (Fig. 280) extends, pushes the lever *8* arm, and turns it. The second arm of the lever *8* shifts the lever *10* aside and releases the frame with the mirror. There is a spiral spring on the mirror frame shaft which returns the mirror to the starting position. The next moment, the transport sprocket pins along with the release gear pins become separated, and the shutter trips. The mechanism of the camera interlocking and shock absorbing is described below. When the release button is pushed and the mirror falls, it hits the wide part of the lever *13* (Fig. 278). The lever *13* turns on the joint *14* to which the lever *15* is attached. The lever *15* then turns along with the lever *13*. The end of the lever *15* is inside the hole in the ledge of the curtain pulley. Therefore, the shutter is blocked and cannot operate until the mirror falls and shifts the lever *13* aside. During the winding of the shutter and the return of the mirror to its starting position, the lever *13* is driven by the spring *2* to its starting position. Apart from its other functions, the lever *13* serves as a shock absorber decreasing the impact of the falling mirror and preventing camera shock.

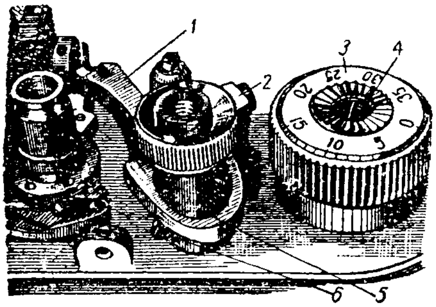


Figure 279. The upper parts of the mirror drive mechanism.

Malfunctions of the mirror drive mechanism. 1. ***The mirror does not retract during the winding of the shutter.*** This is caused by the loosening or falling out of the screw *6* (Fig. 279) on the clutch. If the screw has fallen out, it will always be under the top plate *7* (Fig. 271). Therefore, remove the top plate carefully to avoid loosing the screw and put screw back in place.

2. ***The mirror does not return to its starting position during the operation of the shutter.*** This is caused by the deformation of a lever in the mirror driving mechanism.

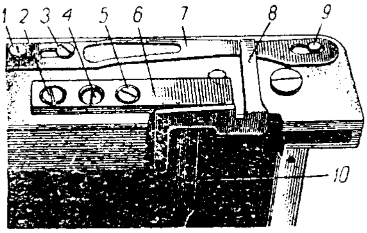


Figure 280. The bottom side of the shutter body.

When the release button is depressed, the lever *8* (Fig.280) turns and makes the fixating lever *10* turn too. When one of these levers is deformed, the fixating lever *10* turns insufficiently, and the mirror remains still.

To correct this problem, take the mechanism out of the body *1* (Fig.271) and check the functioning of the levers *8* and *10* (Fig. 280).

3. ***The mirror does not stay fixed in the wound position during the winding of the shutter.*** This malfunction may arise as a result of the deformation of the levers *8* and *10* (Fig. 280). The repair is the same as described above.

Sometimes the lever *3* (Fig. 278) does not support the mirror frame due to the malfunction of the spring *2*. In this case the spring *2* has to be checked.

4. ***The mirror remains in the working position after the shutter is released.*** This malfunction is also a result of the deformation of the lever *8* or *10* (Fig. 280). The lever 8 turns insufficiently and does not release the mirror frame. To resolve this problem the levers have to be

adjusted. When repairing the lever system, lubricate the shafts of all the levers, the bracket, and the mirror frame.

Lens

The "Zenit" camera is equipped with a coated "Industar-22" lens (Fig. 281). Its optical diagram is shown in Figure 149.

The technical and photographic characteristics of the "Industar-22" lens in the "Zorki" camera and in the "Zenit" camera are practically identical, with the exception of the distance scale range. The "Industar-22" lens for the "Zenit" camera is intended for operation at a distance within a 0.65 m to ∞ range.

The only significant difference is in the lens mounts. The moving mirror located in the rear part of the "Zenit" camera made it necessary to build a deeper body. As a result, the camera working distance (the distance from the top plane of the lens mount ring to the support plate) is considerably larger than the working distance of the "Zorki" camera.

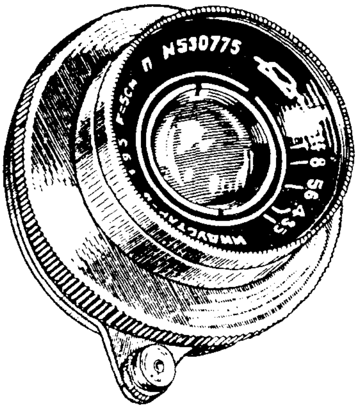


Figure 281. The "Industar-22" lens.

A longer camera working distance created the need for a longer lens working distance. Therefore, the "Zenit" camera lens does not have a barrel, and the lens length is much shorter.

The lens working distance is 45.2±0.02 mm.

Lens malfunctions are relatively rare. Lens adjustment is accomplished with the adjusting shims placed inside the lens. Removing the lens block requires a disassembly of the lens. The disassembly is not difficult and is done as follows. The butt-end has a screw with four holes. Two of them are threaded and hold the locking screws M1.7x0.35 which, in turn, hold the nut. Unscrew these screws, insert the key in the other two holes, and unscrew the nut. Lastly, remove the lens block with the diaphragm.

Camera Adjustment

The adjustment of the camera includes the body and lens adjustment and the mirror finder adjustment.

The body and lens adjustment in the reflex cameras without a removable back cover ("Zenit", "Zenit-C", and "Zenit-3") is done with the aid of the same devices as for cameras with a base rangefinder (FED, and "Zorki"). This is described in detail on p.131. However, due to a significantly longer working distançe in the "Zenit" camera, the indicator rod *3* (Fig. 155) should be made longer as well. To do that, unscrew the cap 4 and install a 16-17 mm extension tube between the rod and cap.

The camera working distance is set according to the lens working distance (45.2±0.02 mm). Similar to the "Zorki" camera, the "Zenit" camera working distance is set 0.03-0.05 mm longer than the lens working distance because the film in the film track curves toward the lens by this amount.

Practically, this is done as follows. Consider a case when the measured lens working distance is 45.22 mm and the measured camera working distance is 45.12 mm instead of the needed 45.27 mm, i.e., 0.15 mm less. Therefore, the camera lens mount ring has to be elevated by 0.15 mm using the adjusting paper shims installed under the ring.

Small deviations in the lens working distance should not be fixed, i.e., the lens itself is not adjusted to the standard. In this case, as was mentioned earlier, the camera working distance is adjusted according to the lens working distance because it is much easier to install a paper shim under the lens mount ring than to disassemble the lens.

The lens adjustment is done only when there is a set of interchangeable lenses, and it is necessary to make their working distances equal.

Having finished the body and lens adjustment, start the mirror-rangefinder adjustment. The viewfinder optical diagram (Fig. 276) shows that the distance from point *O* to the film is equal to the distance from point *O* to the base ground plane of the collective lens element *2*. This position is achieved by the viewfinder adjustment. In reality, this adjustment is achieved by setting the collective lens element and the mirror in correct positions. The collective lens element is adjusted with the aid of the shims placed under it. But this requires removal of the rods *2* (Fig. 275) which is a fairly difficult job. Thus small deviations in the viewfinder adjustment are corrected with the mirror.

Set the lens in the ∞ position, focus the camera on an infinitely distant object, and look into the viewfinder eyepiece. If the image of the infinitely distant object is not sharp, remove the top plate (see p.220) and adjust the mirror. The screws *7* and *9* for adjusting the position of the mirror are shown in Figure 278.

When the shutter is wound, the mirror is fixed by the lever *3* and is set in the working position. The lever *3* can go up and down adjusting the mirror's position. The lever *3* is set on the shaft of the lath *11* which is fastened with the shaft screw *10*. The lath is turned by the screws *7* and *9*. To lower the mirror, untighten the screw *9* by 0.5-1 turn and tighten the screw *7* by the same amount. To elevate the mirror, loosen the screw *7* and tighten the screw *9*. Turn the screws slightly. Do not remove the pentaprism *8*. Having turned the screws, put the top plate with the eyepiece in place and check the sharpness of the image when focusing on an infinitely distant object. Continue trying until a sharp image is achieved. After finishing the work, cement the screws *7* and *8* with shellac glue.

The body and lens are rarely misadjusted which makes camera adjustment much easier. Here is the rule of thumb: if the negatives are not sharp, check and adjust the viewfinder.

"ZENIT-C"

The "Zenit-C" camera (Fig. 282) is an improved version of the "Zenit" camera.

"Zenit-C" is equipped with a flash synchronization mechanism and synchrocontroller; their design and operational principle are the same as those of the "Zorki-C" camera flash synchronization mechanism (see p.143).

The "Zenit-C" camera has an altered and improved mirror drive mechanism. The mirror drive mechanism of the "Zenit" camera consists of a lever train that makes the winding of the shutter mechanism much more difficult. In the "Zenit-C" camera, the winding of the shutter mechanism is simplified. Its design is described in detail below.

The design of the shutter speed knob and the mechanism of the transport sprocket's disengagement when the film is rewound is the same as in "Zorki-C".

Other assemblies and parts are the same as in the "Zenit" camera. Therefore, camera disassembly and reassembly are both done in the same sequence as for "Zenit".

The "Zenit-C" camera has an "Industar-50" lens. A detailed description of this lens can be found on p.153. Keep in mind that the "Industar-50" lens for the "Zenit-C", "Zenit-3", "Crystal", and "Zenit-3M" cameras has a longer working distance than the same lens in cameras with a base rangefinder. Its mount should also be shorter so the rings *1* and *5* (see Fig. 179) are absent from its design.

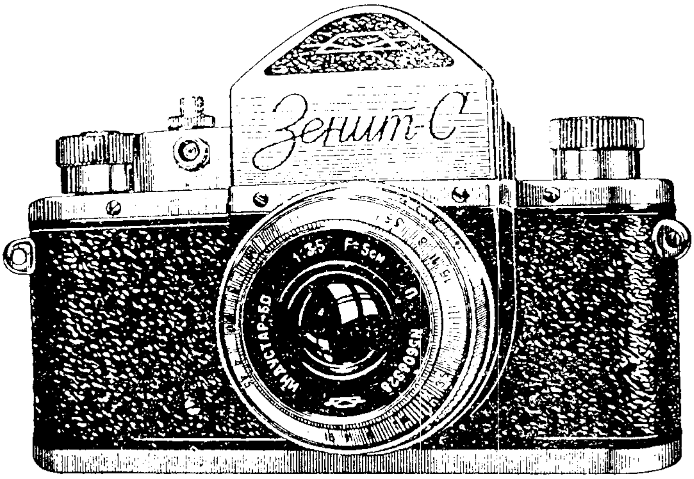


Figure 282. The "Zenit-C" camera.

Camera Disassembly and Reassembly

In connection with the change in the design of the mirror drive mechanism and the film rewind switch mechanism, and because of the addition of the flash synchronization mechanism, it is worth to consider some features of the disassembly and reassembly of the "Zenit-C" camera.

In order to remove the top plate 7 (Fig. 271), remove the synchrocontroller tang fastened with a set screw, in addition to other parts discussed in "Zenit" disassembling description.

Set it in zero position before disassembling.

It was pointed out that the design and repair of the switch mechanism is similar to the "Zorki-C" camera, and they are described in detail on p. 145. Bear in mind, however, that some of the steps in repair work, for example, repair of the connecting couplings inside the transport sprocket (see Malfunction 3 on p.147), are done differently in the "Zenit-C" camera.

It is hard to disassemble the switch mechanism, especially outside of the specialized facilities. In this case, it is better to do work that does not require special knowledge, even if it takes up more time.

It is not recommended to disassemble the "Zenit-C" camera to repair the couplings. ***In general, it is better to avoid complete disassembly of the "Zenit-C" and "Zenit-3" cameras.*** Complete disassembly of these cameras requires disassembly of the mirror drive mechanism which is very complicated.

Therefore, the switch mechanism of the "Zenit-3" and "Zenit-C" cameras is disassembled as follows for coupling repair. Remove the top plate and the camera body (see p.220); unscrew the screw *6* (Fig. 283) and remove the following parts of the release and switch mechanisms: the release button *2* and the spring located under it, the switch clutch *1* and the spring located under the clutch, the rod and the cylindrical coupling inside the base *1*. Then unscrew the set screw *1* (Fig. 284) fastening the gear *3* onto the coupling; unscrew the screw *4* which is located in the slot of the lower coupling and connects it with the transport sprocket *5*; unscrew the screw *2* connecting the transport sprocket *5* to the upper coupling that holds the gear *3*. With the special key (see Fig. 25), unscrew the upper coupling whose slots are seen inside the base *7* (Fig. 283).

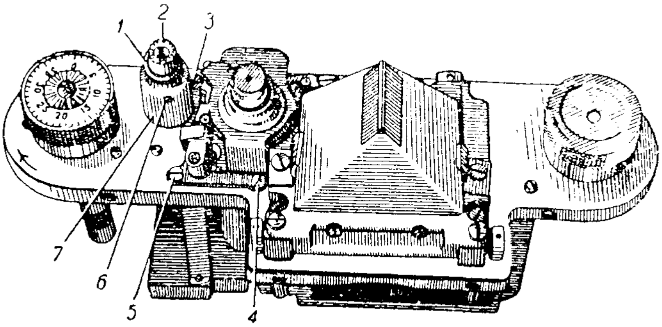


Figure 283. The top assembly panel.

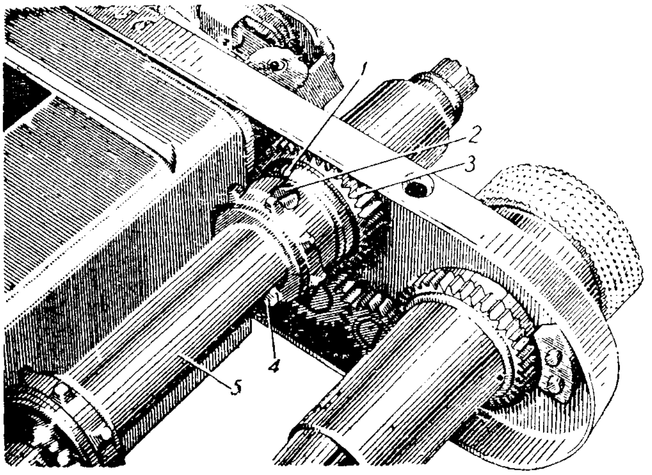


Figure 284. The parts of the switch mechanism.

After the repair is finished, reassembly is done in the reverse order.

The mirror drive mechanism is disassembled as follows. Unscrew two screws and remove the shield which covers the levers shown in Figure 285; unscrew the screws *2* and *5* (Fig. 280) and remove the lath with the lever *8*; free the spring *2* (Fig. 285) by removing its hook from the lever *4* loop; unscrew the screw *4* (Fig. 280) and remove the lath with the lever *1* (Fig. 285). Do not remove the lever *1* (Fig. 286) because it will change the camera's adjustment.

Figure 286 shows the mechanism without the levers. Avoid further mechanism disassembly. The gears *8* and *10* (Fig. 287a) rotate with the aid of the gears *12* and *13* of the focal plane shutter. It is inadvisable to change their positions because it is fairly complicated to reinstall them correctly (see below). It is not recommended to unscrew the screws *1* and *3* (Fig. 280) fastening the spring *7*. The point is that the same screws hold the lath *3* (Fig. 287a) that holds the bracket with the roller *1* and the isolator *4*. Apart from that, it is quite difficult to install these parts correctly.

To separate the shutter body from the top assembly panel, unscrew the screws *3*, *4*, and *5* (Fig. 283) and remove the flash synchronization mechanism. Further disassembly is the same as in the "Zenit" camera. Do not remove the cord of the mirror drive mechanism because it does not interfere with the disassembly.

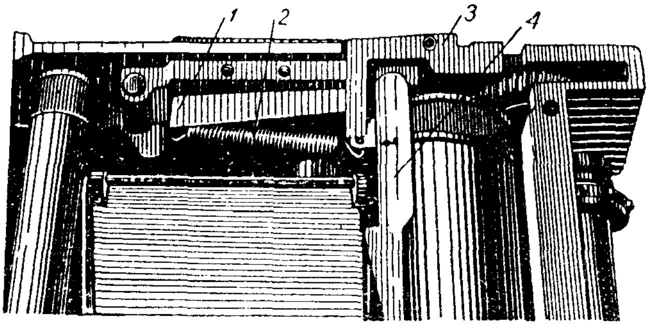


Figure 285. The levers of the mirror drive mechanism.

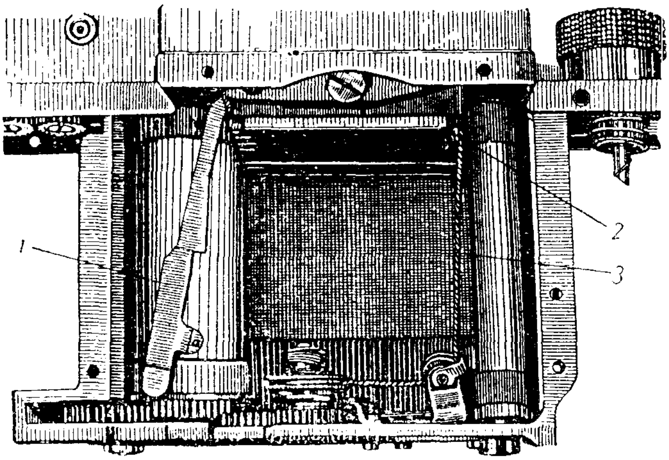


Figure 286. The cord of the mirror drive mechanism.

If during the disassembly of the focal plane shutter the curtain drum with the pulleys was removed, it is necessary to reinstall the mechanism gears correctly. The pulley *12* gear (Fig. 287a) and the restrictive gear *13* (see p.118) are installed first, and after that the gear *10* is connected to the pulley *12* gear.

To simplify the installation of the gears *10* and *8* on the lever *7* attached to the gear *8*, a special notch is made (see arrow in Fig. 287a). Match the gears *10* and *12* when the shutter is unwound, having set the gear *8* to place the notch approximately in the middle of the gear as shown in Fig. 287a.

Mirror Drive Mechanism

The function of this mechanism is to set the mirror to the working position and return it to the starting position. During the winding of the focal plane shutter, the mirror is set to the working position for focusing through the viewfinder-rangefinder. A moment before the shutter trips, the mirror returns to its starting position. All these processes occur in the same sequence as they do in the "Zenit" camera.

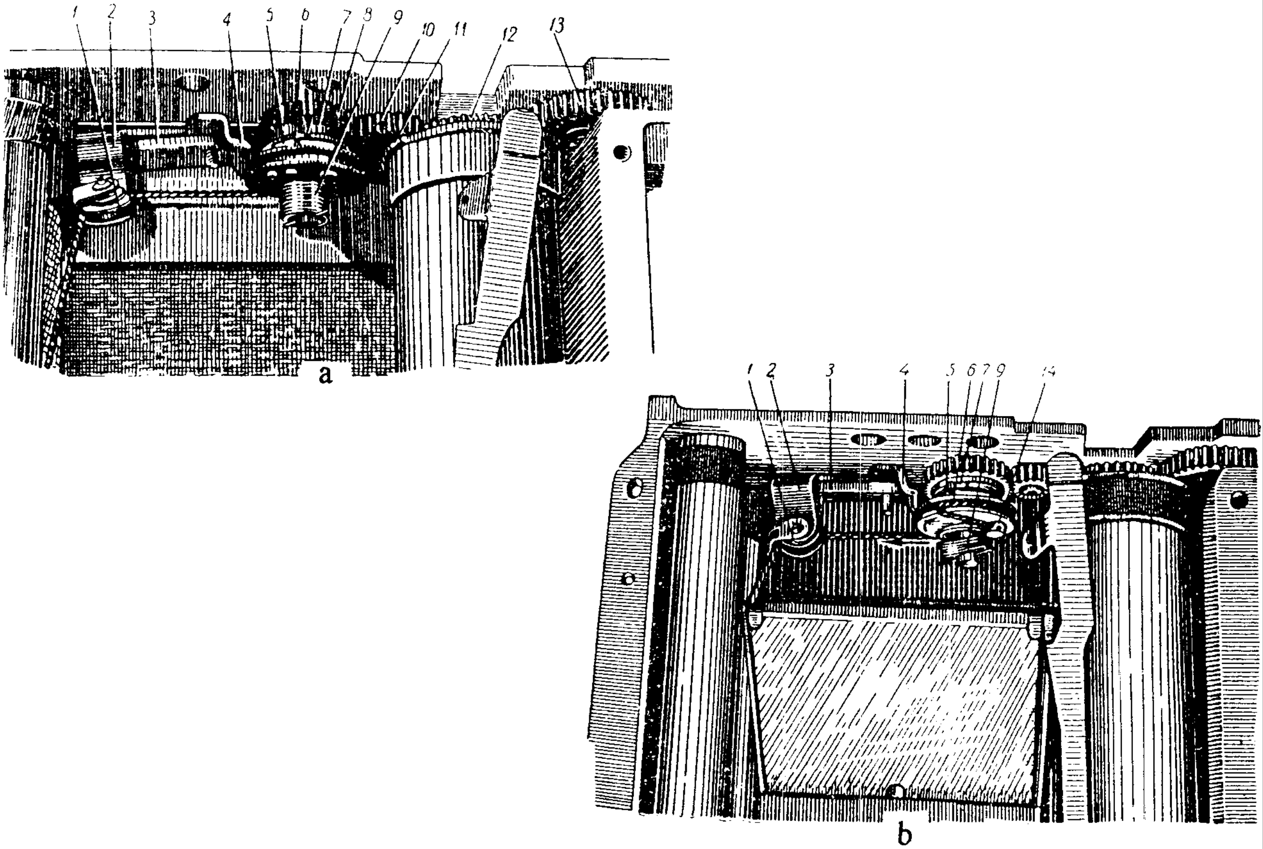


Figure 287. The parts of the mirror drive mechanism:
a - before the winding of the shutter; b - during the winding of the shutter.

The mirror drive mechanism in the "Zenit-C" camera consists of the interlocking lever *1* (Fig. 285), spiral spring *2*, lath with the lever *3*, setting lever *4*, bracket *2* (Fig. 287a) with roller *1*, cord *3* (Fig. 286), lever-isolator *4* (Fig. 287a), disk *6*, spring *9*, and gears *8* and *10*.

Mechanism operational principle. During the winding of the focal plane shutter mechanism, the curtain pulley gear *12* rotates the gear *8* by means of the gear *10*. The gear *8* shaft holds a pulley with a groove for reeling the cord. The pulley freely rotates on the shaft. It is driven by the spiral spring *9*. One end of this spring is attached to the pulley, and the other is hooked on to the shaft slot. This spring should be protected against uncoiling and deformation during disassembly and repair of the mirror drive mechanism. Do not wind it by more than one or two turns.

The spring *5* is attached to the disk *6* with two rivets. Figure 287a shows the top of the spring, and Figure 287b shows the bottom side of the spring and a pin attached to it. The lever *7* is attached to the gear *8*. Figure 287a shows the top part of the lever and its position before the winding of the shutter. Figure 287b shows the bottom side of the lever.

The gear *8* rotates during the winding of the shutter; the lever *7* turns along with it, catches the spring *5* pin (see Fig. 287b), and starts to turn it. One of the cord's ends is attached to the pulley with the screw *14*, while the other one is attached to the loop *2* (Fig. 286) of the mirror frame. When the pulley starts turning, the cord coils around it, and the frame with the mirror goes down. At this time, the semi-rounded tip of the spring *5* (see Fig. 287b) reaches the lever-disconnector *4* that shifts the spring aside and separates the spring pin from the lever *7* which allows the mirror to return to its starting position. But since the mirror frame is below the lever *4* shoulder (see Fig. 285), the mirror remains in the working position.

When the mirror is set to the working position and the lever *7* releases the pulley that freely turns on the shaft, the cord might hang loosely and even fall off the roller *1* and pulley *6*. To avoid this, the spring *9*, which drives the pulley and takes up the hanging part of the cord, is installed. The spring turning the frame of the mirror is much stronger than the spring *9*.

The spring *5* has a beveled pin. When the shutter is being wound, the lever *7* (Fig.287) catches the right angle with its pins and turns the spring with the pulley. When the shutter trips, the lever *7* runs above the beveled side of the pin and stops behind it, so that the next time the shutter is wound, it would catch and turn the spring and the pulley.

If the cord is any shorter than necessary, the lever *7* will be unable to stop behind the spring pin because it always turns by the same angle (approximately 270°). On the other hand, if the cord is too long, the mirror will not reach the shoulder on the lever *4* (Fig. 285) when the shutter is wound and will not stop in the working position. You need to know this when adjusting the mechanism. The operation of the pulley *6* (Fig. 287) and the spring *9* can be seen if the mirror is carefully tilted with a finger.

The order of the disconnector and cord adjustment is discussed below in the description of the possible mechanism malfunctions and their correction.

In conclusion, let us discuss the interlocking device. Note the pulley *11* ledge (Fig. 287a) that has a shoulder and a recess. When the shutter is in the wound state, the pulley *11* catch is positioned behind the lever *1* (Fig. 285), and the other arm of the lever *1* is to the left between the curtain bushing sleeves (the arm is not visible in Fig. 285). When the shutter is released, the spring *7* (Fig. 280) turns the lever *8* which, in turn, shifts aside the lever *4* (Fig. 285) and releases the mirror frame. The falling mirror reaches the lever *1* arm and turns it. With this, the second lever arm leaves the recess on the pulley ledge and allows the curtain pulley to turn. Therefore, the shutter cannot work until the mirror falls. The lever *1* is under pressure from the spring *2* and returns to its starting position during the winding of the shutter. In addition, the lever *1* arm absorbs the impact of the falling mirror.

Mechanism malfunctions. 1. ***The mirror goes down during the winding of the shutter, but does not set in the working position and does not return to the starting position.*** The shutter is not released. This means that the lever *4* (Fig. 287b) does not disconnect the spring *5* and the lever *7*.

To eliminate the malfunction, take the focal plane shutter out of the exterior body, remove the upper levers of the mirror drive mechanism, examine the function of the parts *4*, *5*, and *7* (Fig. 287), and adjust the disconnection of the parts *5* and *7* by gently bending the lever *4*. Also check whether the screws *1* and *3* (Fig. 280) are tightened because if they are not, the bracket *2* (Fig. 287b) may shift from its place.

2. ***The mirror goes down during the winding of the shutter but is not supported by the lever 4 shoulder (Fig. 285) and returns to the starting position.*** This malfunction is caused by the same factor as the preceding one. The repair is the same as for the problem described above.

Check the mobility of the lever *4* before starting to disassemble the camera. To do that, unscrew the lens and, while pushing the shutter release button, check whether the lever *4* turns. If it does not, it may be for one of the following reasons: the spring *2* is loose, the lever *4* shifted from the lath that supports it, the lever *3* is deformed or turns with difficulty. Check the functioning of the listed parts.

3. ***The mirror remains still during the winding of the shutter.*** This happens when the lever *7* (Fig. 287b) does not catch the spring *5* pin during the winding of the shutter. Check the positions of these parts in the starting position, i.e., whether the lever *7* is positioned behind the spring pin. The positions of these parts may be altered as a result of their deformation or the improper installation of the gears *8* and *10* (Fig. 287a). The rules of the gear installation were discussed above in the section on the camera disassembly.

4. ***The mirror falls with a delay.*** In this case, a part of the frame may be unexposed at fast shutter speeds.

Keep in mind that at shutter release, the mirror should fall right before the separation of the pins *1* and *2* (Fig. 123) on the transport sprocket and the release gear. The pins have to separate approximately at the moment when the mirror returns to its starting position and opens the interlocking. An experienced professional can detect this malfunction by ear. A non professional may guess it only after getting a partially exposed picture. However, the mirror should not fall too early either because the object will stop being visible quite a while before the shutter trips.

The timing of the mirror release depends on the position of the lever *4* shoulder (Fig. 285). The mirror frame rests against the lever *4* shoulder, and the timing of the mirror release depends on its position on the shoulder.

Here is how the timing of the mirror release can be adjusted. If the mirror falls too late, slightly bend down the lever *3*, and it will shift aside the lever *4* sooner when the shutter is released. If the release occurs too early, insert a screwdriver in the opening for the lens, catch the lever *4* and gently push it toward the mirror.

5. ***The cord is broken.*** After some time, the cord *3* (Fig. 286) begins to shred and is worn out by the roller *1* (Fig. 287). The broken cord has to be replaced with a new one. Do not tie it up or shorten it. The job requires certain skills because a special cord of a certain thickness is necessary, and it should not stretch. This work is done best at a specialized facility.

Surgical silk or a braided nylon rope can be used for this purpose. A nylon fishing line will not fit. It is possible, however, to use a braided nylon rope from a sea fishing net. A rope that is too thick can be unbraided.

Cord replacement is accomplished as follows. Unscrew the screw *14* (Fig. 287b) by turning it 1.5-2 times, and remove the pieces of the old cord. Try to prevent the uncoiling of the spring *9*. If it does happen, attach the cord and then stretch the spring. Bend the cord end in a loop, put it under the screw *14* head, and tighten the screw. Then turn the pulley *6* 1-2 times clockwise while gently bending down the spring *5* because it catches the lever *7*. Run the cord slightly to the left along the pulley surface (see the arrow in Fig. 287b) up to the slot, and turn the cord to the right along the groove on the pulley (hold the pulley with a finger of your left hand). Having wrapped the pulley, run the cord toward the roller *1*.

To make sure that the work is done properly, let go of the cord and see whether it coils around the pulley. The pulley has to turn counter-clockwise driven by the spring *9*. If this does not happen, the spring *9* is wound incorrectly, and you should redo the work.

Now run the cord under the roller *1*, and glue the end to the roller. Run the other end of the cord (the cord's length did not matter up to this moment) through the loop *2* (Fig. 286) and precisely adjust the cord's length that was first set only approximately. Tie a loose knot and without cutting the cord, check the operation of the mechanism. Pay particular attention to the operation of the parts *5* and *7* (Fig. 287b). Having set the cord's length correctly, tighten it, and cover it with shellac glue. Cut off the rest of the cord. Also glue the other end of the cord under the head of the screw *14*.

Lastly, lubricate the shafts of the roller and pulley with watch oil.

"ZENIT-3"

The "Zenit-3" camera (Fig. 288) is an improved version of the "Zenit" and "Zenit-C" cameras. It is equipped with a selftimer and a lever recess mechanism. The location and design of the selftimer is the same as in the "Zorki" camera (see details on p.149). The lever recess mechanism has an original design that is described in detail below. In addition, the above-mentioned improvements changed the shape of the top plate and the camera disassembly sequence.

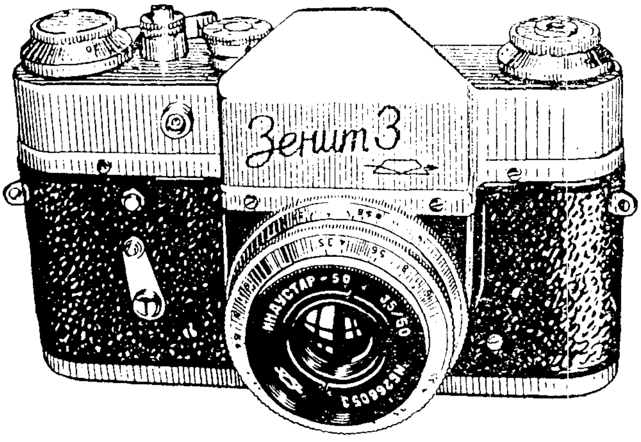


Figure 288. The "Zenit-3" camera.

All the other parts and mechanisms are the same as the corresponding parts in the "Zenit" and "Zenit-C" cameras.

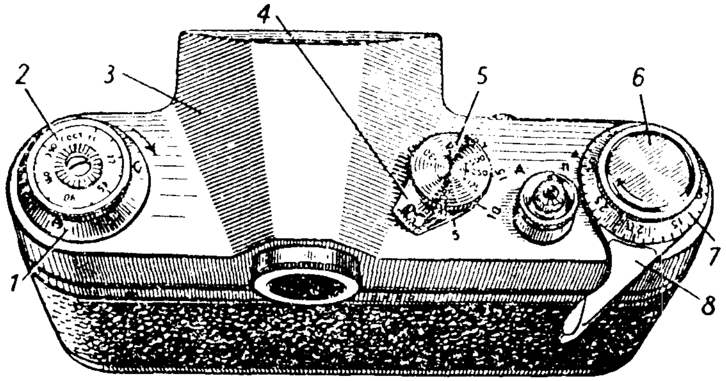


Figure 289. The top plate and exterior parts.

The "Zenit-3" camera is equipped with the "Industar-50" or "Helios-44" lens. The "Industar-50" lens is the same as in all the other models of the camera group being described.

Camera Disassembly and Reassembly

Partial disassembly (removing the top plate and extracting the mechanism from the body) is done as follows. First, wind the shutter and unscrew the screw *6* (Fig. 289); its head does not have a slot, and no tool may be used for unscrewing the screw. You will have to cover the screw head with a piece of rubber, and unscrew it with your thumb. Then remove the exposure counter dial *7* and the spring washer located under it. Unscrew the nut *2* (Fig. 290) which has two holes for the tool, and remove the take-up spool friction clutch with the shaft (see Fig. 293); unscrew the nut *3* (Fig. 290) and remove the spring washer and the winding lever *1*; unscrew the two set screws and remove the speed setting knob *5* (Fig. 289); set the tang *4* at the zero position;

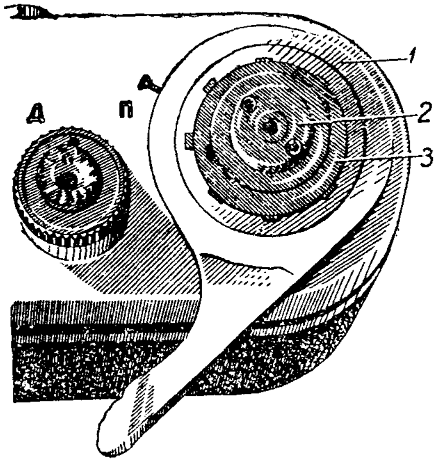


Figure 290. The parts of the winding mechanism.

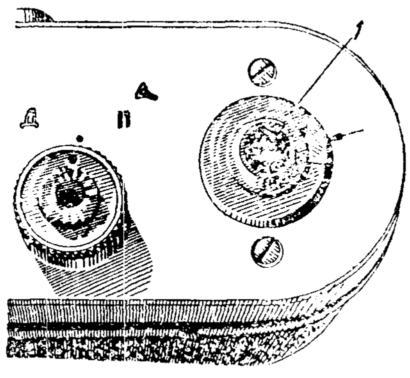


Figure 291. The winding coupling.

unscrew the set screw and remove it; unscrew the film rewind mechanism knob *1* while holding the rewinding knob located inside the camera with pliers. Do not remove the film type reminder scale *2*. Unscrew six screws that fasten the shield: two short screws with flat heads are located under the winding lever, two long black screws are under the film rewind knob, and two screws with round heads are located in the front part of the shield (the screws must not be mixed). Do not remove the winding clutch *1* (Fig. 291).

To remove the mechanism from the body, unscrew the screw and remove the winding lever of the selftimer with the adapter. Then unscrew the two screws on the front of the body and the six screws on the sides of the assembly plate.

Further disassembly is done as in the "Zenit-C" camera.

Winding Mechanism, Brake Device, and Exposure Counter

The winding of the focal plane shutter, the film transport, and the counting of the exposed frames are all done by the winding mechanism that is put into operation by a turn of the lever *8* (Fig. 289). All these units interact.

Design and operational principle. The winding lever *1* (Fig. 290) is set above the winding coupling *1* (Fig. 291) and fastened with the nut *3* (Fig. 290) that is screwed onto the winding shaft.

The coupling *1* (Fig. 291) is not fastened and can be easily removed; it is fitted on the winding shaft that has two slots. The coupling should be installed as shown in Figure 291.

A mill in the coupling serves as a mark for correct coupling installation (see arrow in Fig. 291).

Figure 294 clearly shows the coupling *3* and the shaft which is bearing it.

The pin *2* (Fig. 292) is on the bottom side of the lever *1*. This pin engages the coupling mill at the lever installation. The coupling mill is much larger than the pin on the winding lever. This is done so that the lever has an idle stroke and can be put away, i.e., pressed to the release button, when the camera is not in use.

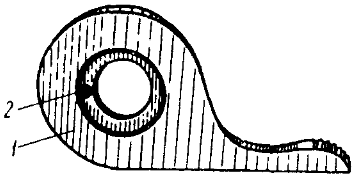


Figure 292. The winding mechanism lever.

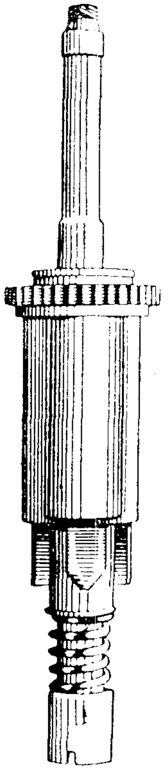


Figure 293. The take-up spool friction clutch with the shaft.

When the lever *1* (Fig. 290) turns at the winding of the shutter, the coupling *3* (Fig. 294) rotates the winding shaft that makes the gear *9* move with the aid of a special device (it will be discussed below). The gear *9* rotates the gear *11* on the shaft *1*. The gear *6* (Fig. 295) is fastened with a screw on the same shaft; this gear rotates the gear *2* that turns the transport sprocket *1* and the two intermediate gears *3* and *4*. The gear *4* rotates the take-up spool friction clutch gear (Fig. 293). The Figure 295 shows the rewinding mechanism without the take-up spool friction clutch.

The friction clutch and the shaft of the take-up spool turn in one direction that is opposite to the winding lever movement. The exposure counter dial *7* (Fig. 289) is located on this shaft.

The winding lever's movement is severely restricted in either direction (if the winding of the shutter is done with one lever motion). The movement of the winding mechanism gear and lever during the winding of the mechanism is controlled by a restrictive gear (see p.116). When the lever returns to the starting position after the winding of the shutter, the winding mechanism gears remain still; only the lever and the shaft of the winding mechanism turn. The reverse movement of the lever is restricted by the pin installed on the disk *2* (Fig. 294). The second pin is located on the base *4*.

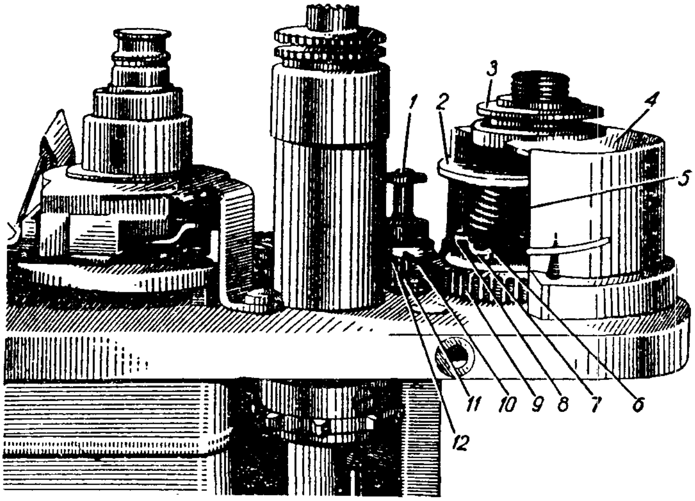


Figure 294. The winding mechanism base and brake lever.

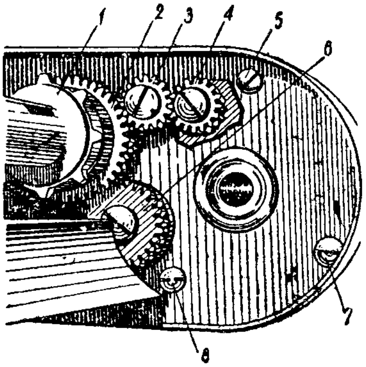


Figure 295. The base of the winding mechanism.

The winding lever is returned to the starting position by the spiral spring *5*. One of the spring's ends is hooked to the disk *2*, and the other one is hooked to the base *4*.

It was pointed out earlier that the winding mechanism remains still when the lever is returning to the starting position. This is due to the ratchet-wheel and pawl that are installed above the gear *9* (Fig. 294). After the mechanism is wound, hold the camera against your ear and slowly return the winding lever to the starting position. Two clicks can be heard at this moment.

The ratchet-wheel is located on the bottom of the winding shaft (not shown in Fig. 294), and the pawl *6* is on the gear *9*. The pawl is pressed against the ratchet-wheel by the spring *7* fastened with the screw *8*. When the mechanism is being wound, the pawl *6* gets in one of the ratchet-wheel teeth and rotates the gear *9*. When the wheel's motion is reversed, the pawl slides along its smooth surface, and the gear *9* remains still.

The purpose of the brake device is to prevent the curtains from returning to the starting position arbitrarily after the winding of the shutter (curtains are driven by the springs), and to ensure that the gear *9* remains still. The lever *12* with the bending *10* is installed above the gear *11* on the shaft *1* for this purpose. This lever is tightly pressed against the gear *11* and can turn in either direction. When the mechanism is being wound, the gear *9* rotates counter-clockwise, and the gear *11* turns clockwise. At this time the gear *11* shifts the lever *12* to the left, and the bending *10* moves away from the teeth of the gear *9*. When the winding of the mechanism stops and the gears driven by the curtain springs start to turn in the opposite direction, the bending *10* gets in the gear *9* teeth and stops the mechanism.

Mechanism malfunctions. 1. ***The winding lever does not turn, and the mechanism cannot be wound.*** It is sometimes impossible to wind the mechanism. This happens when the shutter has not been released after the last winding.

This problem is caused by a jammed shutter or a malfunction of the mirror drive mechanism. First, check the functioning of the mirror. Without disassembling the camera, slightly shift the lever *4* (Fig. 285) aside. The mirror should now return to its starting position. If the mirror does not fall, the mirror drive mechanism is malfunctioning (see p.231). The shutter will not function until the mirror falls.

If the mirror did fall, but the mechanism still cannot be wound, the focal plane shutter is not working. One possible cause could be a jammed shutter. Remove the shutter from the body without taking off the top plate, depress the release button with your right hand, and gently pull the curtains to the starting position with your left hand. If this does not help, check whether there are pieces of film between the gear teeth.

This malfunction can also be caused by other factors described on pp. 120, 121.

2. ***The winding lever turns, but the shutter cannot be wound.*** Check the pin *1* (Fig. 292). Sometimes, due to a loosening of the nut *3* (Fig. 290) and the excessive space in the winding lever *1*, the edge of the pin *2* (Fig. 292) wears out, and it does not catch the edge of the mill in coupling *1* (Fig. 291). This edge of the mill in the coupling may be damaged as well.

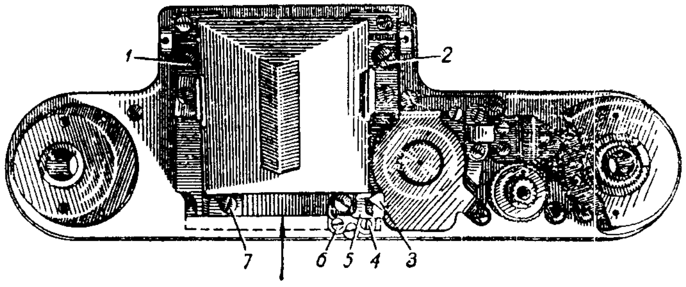


Figure 296. The top assembly plate.

File the mill edge in the coupling and pin, and make straight corners. The pin can be replaced.

If the pin is in good condition, check the pawl *6* (Fig. 294). Sometimes the pawl tooth wears out and stops functioning. Try to correct the pawl tooth without disassembling the mechanism since it is a fairly complicated process. Turn the gear *9* to position the pawl as shown in Figure 294. Then free it of the spring *7* and correct the pawl tooth with a file, i.e., sharpen it. If this method fails, you shall have to make a new pawl. To disassemble the winding mechanism, unscrew the screws *5*, *7*, and *8* (Fig. 295) and remove the base *4* (Fig. 294). Examine and memorize the positions of the clutch *3*, the spring *5*, and the other parts of the mechanism before beginning the disassembly.

The malfunction described above may be caused by a loosening of the screw that fastens the gear *6* (Fig. 295). Put the gear in place and fasten it with a screw.

3. ***The shutter can only be wound half-way.*** This problem is caused by the displacement of the lever *2* (Fig. 297). The lever *2* rests against the plate *1*, and its correct position is shown in Figure 297. When the release button is pushed, the lever moves freely. If the lever's end slips off the plate *1* and sets to the left and below it, the lever catches the curtain pulley shoulder *3* (this shoulder serves for release interlocking, see p.231) when the mechanism winds and blocks the winding of the shutter. The curtains go only half-way. This is how the malfunction is manifested in the "Zenit-3" camera. This problem is much more common for the "Zenit-3M" and "Crystal" cameras, and the manifestations are somewhat different.

This malfunction can be eliminated without disassembling the camera. Lift and put in place the lever *2* through the hole for the lens. Correct lever installation can be verified by depressing the release button. At this point, the lever should move.

Optical Viewfinder

The design of the viewfinder-rangefinder is described in detail on p. 223, and the mirror drive mechanism, on p.231.

A typical viewfinder malfunction pertaining to early "Zenit-3" camera modifications is fogging up of the film due to the light penetrating through the hole for the viewfinder. The light penetrates the camera through the hole where the pentaprism base is located.

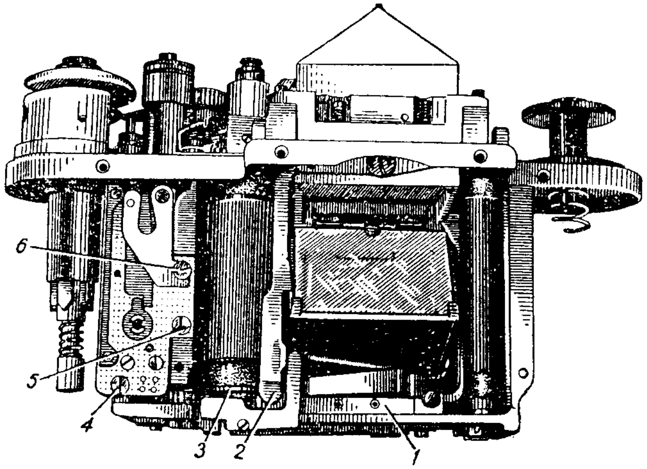


Figure 297. The shutter and the selftimer mechanism.

This problem is corrected as follows. Remove the top plate, unscrew the screws *1*, *2*, *4*, and *6* (Fig. 296) by turning them once or twice, remove the screw *7*, slightly lift the pentaprism base, and put a black paper strip under it (see arrow). The strip size is marked with a dotted line. Make sure that the plate with the bending *5* is in place and the tip of the lever *3* rests against the bending. Lastly, tighten the screws and reassemble the camera.

Shutter and Selftimer Mechanism

The design of the camera shutter is the same as that of the shutter in the FED and "Zorki" cameras (see p.115). The selftimer mechanism is fastened on the body with the screws *4*, *5*, and *6* (Fig. 297). Its detailed description can be found on p. 149.

"Helios-44" Lens

The "Helios-44" lens is a fast six-lens anastigmatic. Its optical diagram is shown in Figure 299. "Helios-44" lenses are intended for reflex cameras of the "Zenit" and "Start" type. They are manufactured with two kinds of mounts: one with a thread for the "Zenit" camera type and a bayonet mount for the "Start" camera type (see p.301). The "Start" camera is completed with an adapter ring for the "Zenit" camera lens.

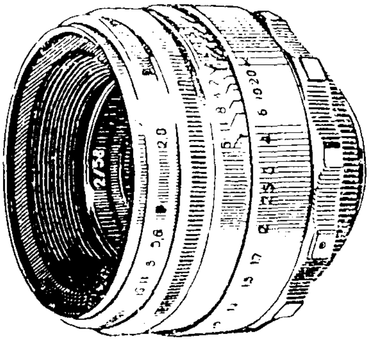


Figure 298. The "Helios-44" lens.

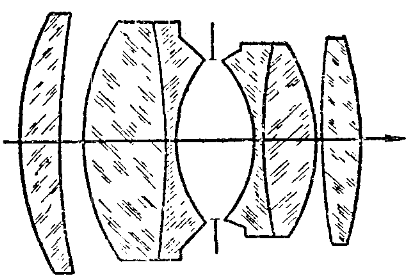


Figure 299. An optical diagram of the "Helios-44" lens.

An obvious advantage of the "Helios-44" lens is a diaphragm of a new design. This diaphragm can be one of two kinds: a pressure diaphragm (in the "Start" camera) and a preset diaphragm (in the "Zenit" camera).

Specifications

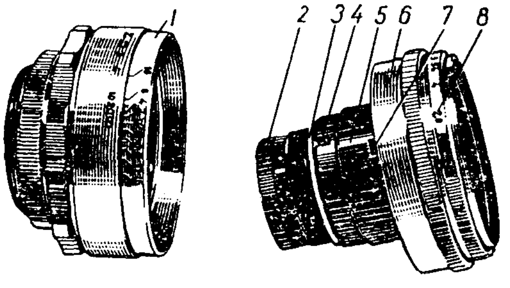
Focal length	58 mm
Relative aperture	1:2
Field angle	40^{0}
Relative aperture range	2; 2.8; 4; 5.6; 8; 11; 16
Distance scale range	from 0.6 m to ∞
Resolution in lines per 1 mm:	
in field center	35
on field edges	14

Lens design and disassembly. The lens consists of the mount-block *b* (Fig. 300) where all the optical parts and the diaphragm are located, and the exterior mount *a* for axial movement of the mount-block. The mount-block is tightly screwed on a thread and is not fixed with a set screw. To unscrew it, hold the knurled part of the mount in your left hand and diaphragm setting ring in your right hand.

The mount consists of the base and barrel which are connected by multi-entry threads, and the guiding screw which moves in the base groove. If the ring with the depth of field scale *1* (Fig. 300a) is removed, the multi-entry threads become visible. The ring *1* is fastened with three the set screws. The screws come into view when the mount is in the "0.5 m" position.

The lens block is basically the same as in other lenses. The front lens element is easily removed by unscrewing a nut which has two slots. The rear component *2* (Fig. 300b) can easily be unscrewed by hand.

The diaphragm is the same as in the other lenses (see p.33). The only addition is a fixatory (clicking mechanism) and a diaphragm presetting mechanism. Here is its design. The diaphragm tang *6* is fastened with three set screws; the tang comes off when these are removed. Then, without further disassembly, observe and study the mechanism's operational principle. Having set the ring *8*, for example, in the position "∞", turn the diaphragm ring *5* and observe the screw *7* that, having reached the spring *2* (Fig. 301), stops the movement of the ring *5* (Fig. 300b). The farther you turn the ring *8*, the less turning the ring *5* is allowed. When the diaphragm is set to "2", the ring *5* cannot turn at all. To see the clicking mechanism, remove the ring *5*. To do that, unscrew the screw *4* that connects the ring *5* with the diaphragm crown. Unscrew the ring after making a mark on it next to the screw *4* and a matching mark on the block base. This is done to simplify the installation of the ring when reassembling.



a

b

Figure 300. A disassembled lens:
a - the exterior mount; b - the mount-block.

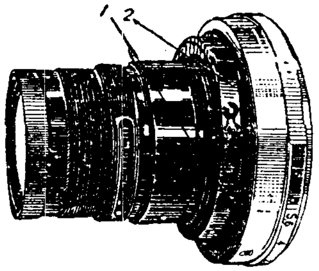


Figure 301. The diaphragm mechanism parts.

When the ring *5* is removed, it fully uncovers the spring *2* (Fig. 301); a cylindrical roller is located under the spring's figured tip. Turning the tang *8* (Fig. 300b) reveals the operation of this mechanism. In the place where the tang *8* is secured the movement of the ring is restricted by the screw *1* (Fig. 301).

Lens adjustment. "Helios-44" is used as a main or interchangeable lens. If "Helios-44" is used as the main and only lens, its adjustment is similar to the "Zenit" camera lens adjustment (see p.226). If "Helios-44" is installed as an interchangeable lens, the adjustment of the camera and the

"Industar-50" lens must not be disrupted. It is preferable to adjust the "Helios-44" lens if needed. The adjustment is done as follows. Unscrew the lens block (see the above) which has the adjusting rings *3* (Fig. 300b). By alternating their thickness, find such a position of the block setting where the scale of the lens mount range would be in the "∞" position while the viewfinder-rangefinder is focused on an infinitely distant object.

The amount by which the adjusting rings' thickness is increased or decreased is approximately 5-10 μ.

Lens malfunctions in "Helios-44" are relatively scarce. If a malfunction does occur, it is usually one of the following. 1. ***Certain parts of the mount and lens block become loose.*** In the process of the operation of the lens some of its parts may become loose, for example, the range scale ring, the diaphragm tang, etc. These parts are fastened with set screws that have to be tightened. If the rings have been displaced, their former positions can easily be detected by finding the holes drilled under the screws.

The correct positions of the block exterior parts are easy to find by matching the red dots (indexes) on the lens mount ring and the ring *8* (Fig. 300b).

2. ***The lens mount is hard to turn.*** Unscrew the block and remove the ring *1* (Fig. 300a) or, without unscrewing it, loosen the three set screws and remove the knurled ring. This uncovers the multi-entry threads which have to be lubricated with watch oil.

3. ***The diaphragm fixating mechanism works poorly or does not work.*** Disassemble the lens and examine the screw *7* (Fig. 300b) and spring *2* (Fig. 301).

4. ***The lens is dirty.*** Usually it is enough to unscrew the rear component with the fourth, fifth, and sixth lens elements in order to clean the lens. This does not require lens disassembly. The rear component is located in the back of the lens and has two slots. It is unscrewed with a key (see Fig. 25). Do not confuse it with the lens elements' fastening, whose nut slots are located nearby.

"CRYSTAL" AND "ZENIT-3M"

The "Crystal" (Fig. 302) and "Zenit-3M" (Fig. 303) cameras are identical. First the camera was marketed under the name of "Crystal", and then "Zenit-3M".

The "Crystal" camera has different kinds of top plate finish: painted and chromed; "Zenit-3M" can only have the chromed one.

The design of these cameras is quite similar to the design of the "Zorki-6" camera and differs from it by the added mirror finder-rangefinder. The camera body, the removable back cover, the lever winding mechanism, the focal plane shutter, the film track, the take-up spool, the brake device, and the exposure counter are the same as the corresponding parts of the "Zorki-6" camera (see p.192).

The mirror finder-rangefinder is the same as the viewfinder-rangefinder in the "Zenit" camera (see p.223).

These cameras are equipped with the "Industar-50" lens.

The disassembling of most parts and of the entire "Crystal" camera is analogous to the disassembly of the "Zorki-6" camera (see p.192). The difference in the shapes of the body and the top plate of the "Zorki-6" and "Crystal" cameras does not affect the disassembly sequence.

The viewfinder-rangefinder is fastened with the screws *1*, *2*, and *7* (Fig. 296) and is a single mechanism (see Fig. 306a, b). The removable mirror finder-rangefinder of the "Crystal" camera makes the disassembly and reassembly of the focal plane shutter easier compared to the "Zorki-6" camera because removing the viewfinder makes the interior of the camera more accessible (see Fig. 305). The disassembly of the shutter requires removal of the viewfinder-rangefinder. Before removing the bridge *6* (Fig. 304), take out the lever *3* fastened with the screw *2* which has a left hand thread.

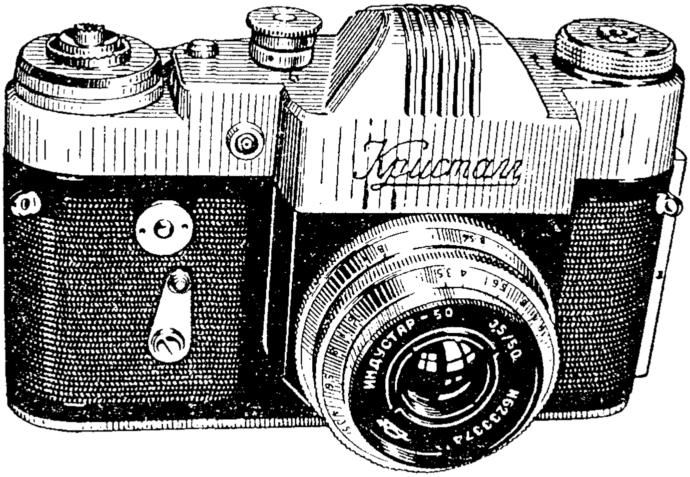


Figure 302. The "Crystal" camera.

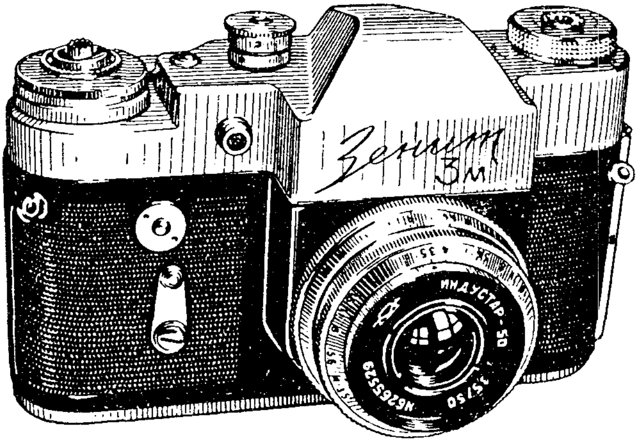


Figure 303. The "Zenit-3M" camera.

Further disassembly and reassembly is done as in the "Zorki-6" camera.

The design of the mirror drive mechanism is fairly simple. The gear *4* (Fig. 304) makes one full turn during the winding of the shutter. The pin *5* on the gear *4* turns the lever *3* which has the screw *1* (Fig. 305) on the opposite arm. The screw butt-end rests against the upper arm of the lever *2* (Fig. 306b).

When the lever *3* (Fig. 304) turns, the lever *2* (Fig. 306b) turns too, pressing the mirror frame *1* and lowering it. The next moment, the pin *5* (Fig. 304) releases the lever *3*, and the mirror is allowed to return to its starting position. However, the lever *1* shoulder (Fig. 306a) prevents this from happening, and the frame with the mirror remains in the working position.

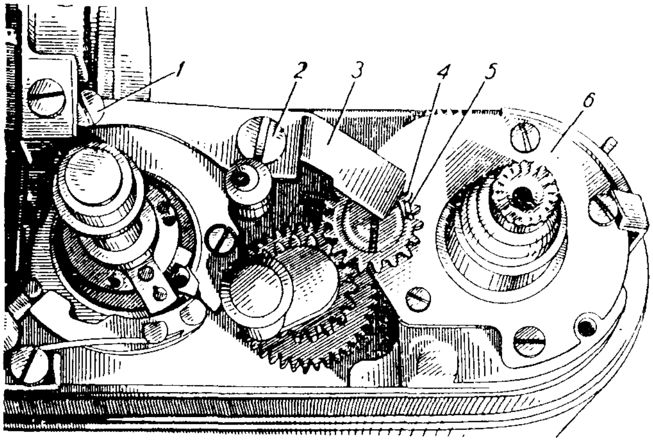


Figure 304. The upper parts of the mirror drive mechanism.

When the shutter release button is pushed, the lever *3* (Fig. 285) shifts the lever *4* aside, and the mirror, driven by the spring *6* (Fig. 306a), falls into the starting position. The lever *2* (Fig. 306b) does not prevent the mirror from falling.

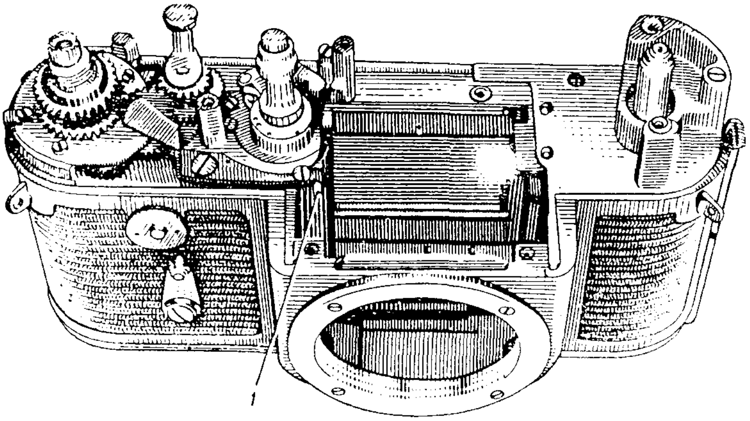


Figure 305. The general view of the camera with the viewfinder removed.

The mirror drive mechanism has an interlocking device which is similar to the one in the "Zenit"-type cameras, and which was discussed in detail on p.225.

Figure 306a clearly shows the parts *2*, *3*, *4*, and *5* which are used for mirror adjustment (see p.226).

Mechanism malfunctions. Most of the possible malfunctions in the "Crystal" and "Zenit-3M" cameras are caused by the malfunctioning of the mirror drive mechanism.

1. ***During the winding of the shutter, the mirror goes down but does not stay in the working position.*** If this is the case, examine the movement of the mirror during the winding of the shutter. Sometimes the mirror does not go below the level of the lever *1* shoulder (Fig. 306a) and, therefore, does not stay in the wound position. To make the mirror go a little lower during the winding of the shutter, the lever *2* (Fig. 306b) has to turn at a greater angle. The lever *2* turns the lever *3* (Fig. 304) with the aid of the screw *1* (Fig. 305) whose butt-end rests against the lever *2* arm (Fig. 306b). To make the lever *2* turn at a greater angle, tighten the screw *1* (Fig. 305) by turning it once or twice. To do that, loosen the screw *1* (Fig. 304) by one turn, tighten the screw *1* (Fig. 305), and then retighten the screw *1* (Fig. 304).

In some modifications of the "Crystal" camera, there is no screw *1* (Fig. 305), and the adjustment is done by slightly turning the flange on the right arm of the lever *3* (Fig. 304). Do not bend the pin *5* because it will break off.

2. ***The mirror does not return to the starting position, and the shutter does not trip.*** The mirror and the shutter are interlocked. The shutter cannot operate until the mirror returns to the starting position.

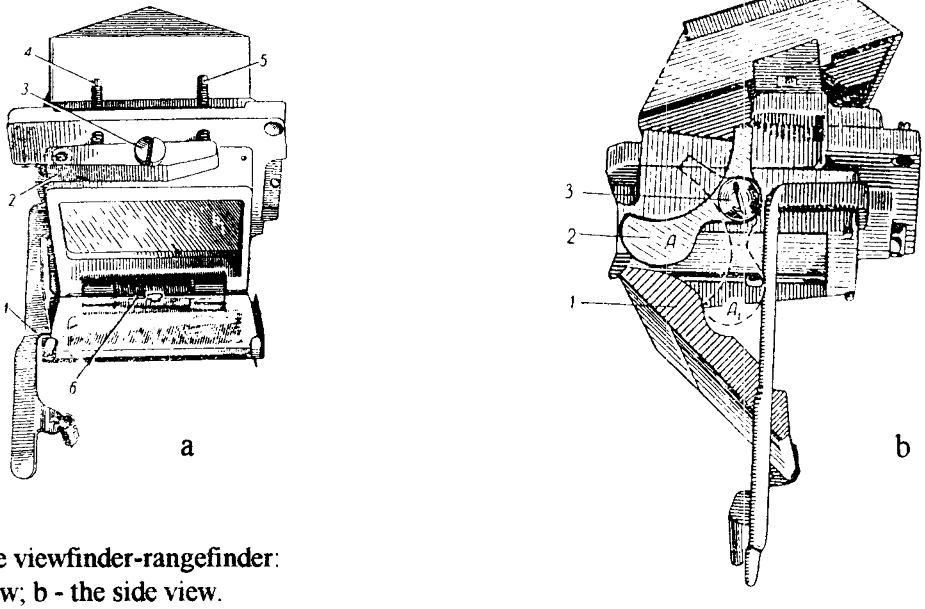


Figure 306. The viewfinder-rangefinder:
a - the front view; b - the side view.

The reason for this malfunction is the improper positioning of the lever *2* (Fig. 306b). When the mirror frame *1* falls, it slides along the surface of the lever *2* which simultaneously turns and does not interfere with the movement of the mirror. Sometimes the lever *2* is in the position

A_1 instead of the A position, and the mirror cannot fall. As a result, the shutter cannot operate either.

The correction of this malfunction does not require disassembly. Gently press the lever *2* with your finger and put it in place.

To avoid this problem, some models of these cameras are made with the lever *2* driven by a spiral spring.

This problem may be caused by yet another factor. The edge of the lever *2* slips from the mirror frame ledge and sets between the frame and the curtain drum. Put the lever in place. If the problem persists, eliminate the looseness of the lever *2*. To do that, unscrew the screw *3* and put in a thin washer.

3. ***The shutter can be wound only partially.*** This malfunction is described in detail in Malfunction 3 on p.239.

"KIEV-2", "KIEV-3", "KIEV-2A", "KIEV-3A", "KIEV-4A", AND "KIEV-4" CAMERAS

"Kiev-2" was manufactured first in the camera group being described. All the rest of the models are improved versions of the "Kiev-2" camera and differ from it very slightly. The "Kiev-3" camera has an added exposure meter; "Kiev-2A" and "Kiev-3A" are respectively "Kiev-2" and "Kiev-3" cameras equipped with a flash synchronization device for the flash. "Kiev-4A" is an improved modification of "Kiev-2A" with some parts of the body and plate having been altered but with the same design of the major camera devices. "Kiev-4" is the "Kiev-4A" camera with an added compact exposure meter. Below is a detailed description of the "Kiev-2" camera and the changes in the later modifications.

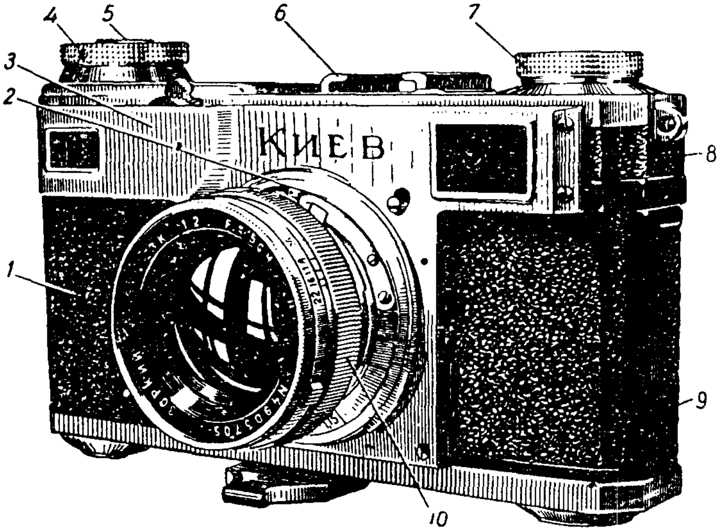


Figure 307. The "Kiev-2" camera.

The "Kiev"-type cameras have the following advantages: the back cover is removable, the second cartridge can be used instead of the take-up spool which is convenient for extracting a part of the exposed film, the rangefinder base is large and provides increased accuracy for lens focusing, the shutter is original and allows speeds from 1/2 to 1/1250 sec and the "B" speed, the shutter curtains are metal which allows the camera to be used at low temperatures, and the lens mount is bayonet for fast changing of the lenses without the risk of misadjusting the rangefinder.

Most of the camera devices (particularly the shutter) are so complex that they can only be disassembled and repaired by experienced specialists.

"KIEV-2"

Major Exterior Camera Assemblies and Parts

The camera consists of the body *1* (Fig.307), lens barrel *2*, front shield *3*, winding knob *4*, release button *5*, accessory shoe *6*, film rewind knob *7*, top plate *8*, back cover *9*, and lens *10*.

Camera Disassembly and Reassembly

Most malfunctions of the "Kiev-2" camera are eliminated when the camera is partially disassembled. This process consists of removing the top plate *11* (Fig.308), the screen *12*, and the front shield *3* (Fig.307). The parts that need to be removed for different kinds of repairs are described below.

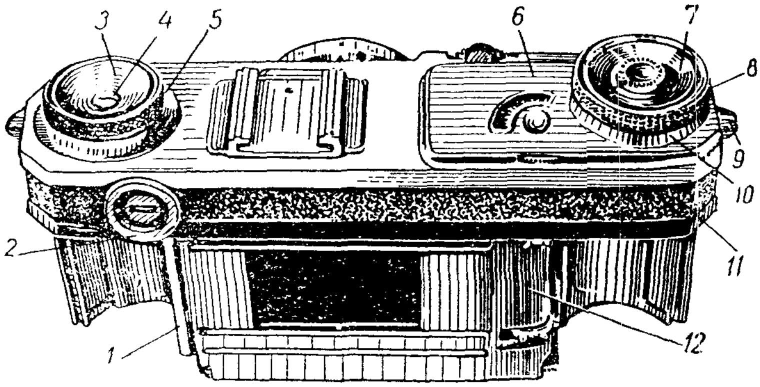


Figure 308. The camera without the back plate.

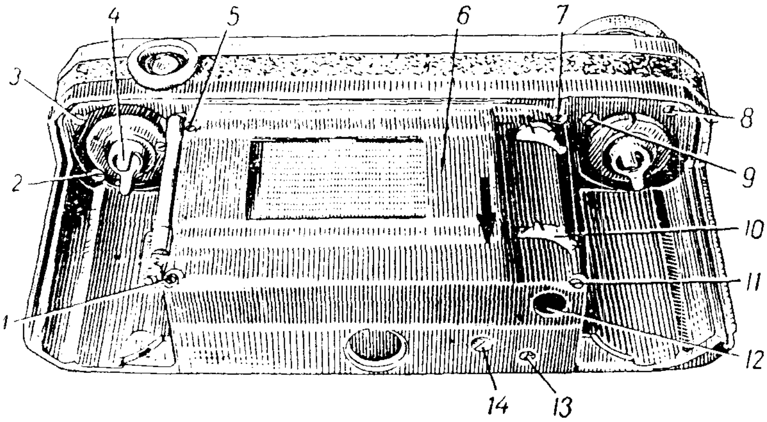


Figure 309. The screen and the film track.

To remove the top plate *11* (Fig.308), you should unscrew the three screws on the side of the winding knob *8* (paying attention to the distance between the screws). Take out the release button with the ring *7* and the spiral spring located under the release button. Unscrew three

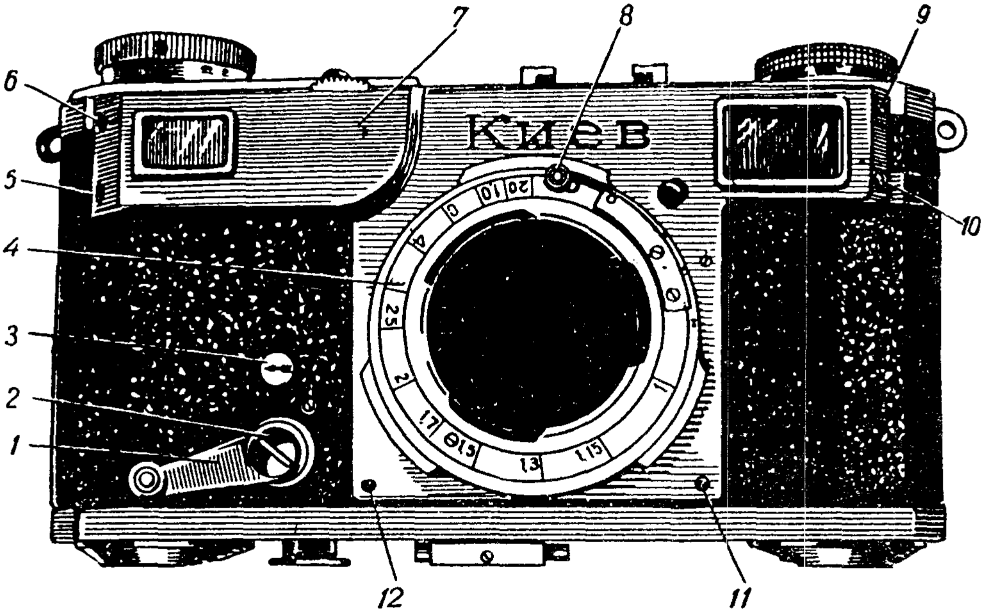


Figure 310. The camera's exterior parts.

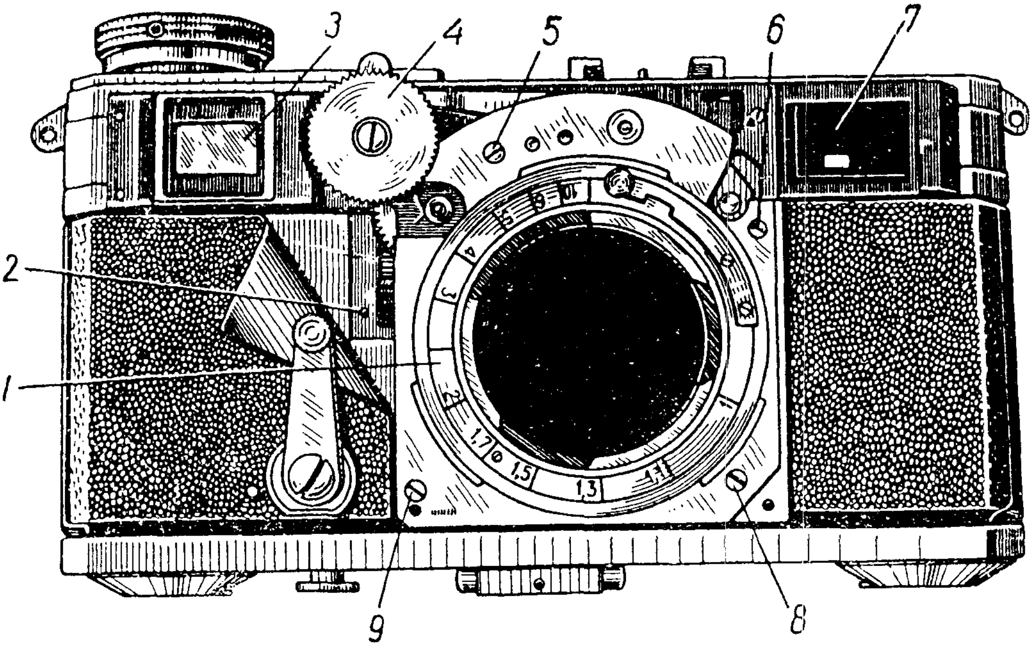


Figure 311. The parts located under the front shield.

screws and remove the winding knob *8*, unscrew two screws, and remove the ring with scale *10*. There are round metal washers under the ring which serve for minimizing the gap between the ring and the winding knob, and for setting the scale in the horizontal position. Install the washers in their former position at reassembly.

You should next unscrew the screw *4* and remove the rewind knob *5*. It is not necessary to take out the bushing *3*. There is a spring washer under the knob *5* which has to be removed. Round brass washers used to adjust the height of the knob 5 may be located there as well. Remove them and reinstall when assembling. After that, remove the chromed shield *6* and the exposure counter disk. The eyepiece *2* is fixed and should never be removed.

Unscrew the screws *2*, *3*, and *8* (Fig.309) and remove the top plate. There is an anti-dust cord between the plate and the body which has to be glued with shellac at reassembly.

In order to remove the screen *6*, unscrew the screws *1*, *5*, *7*, and *11* (screws *7* and *11* are slightly shorter than screws *1* and *5*). The black sleeve of the sprocket *10* can be seen through the hole *12*. This sleeve is fastened with a screw which should be loosened by 2.5-3 turns. (This allows the transport sprocket *10* to go down, see arrow.) You should then lower the screen *6* (see arrow) and remove it. Be particularly careful to avoid breaking the screen or the lug of the shutter frame.

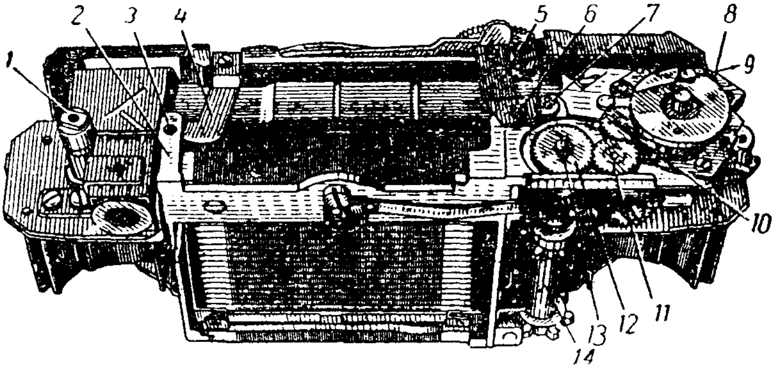


Figure 312. The positions of the parts when the camera is partially disassembled.

It is better not to remove the screen before the top plate *11* (Fig.308). However, sometimes repair requires the removal of the screen alone. In this case, you should not remove the top plate *11* or loosen the fastening screw of the sprocket sleeve by 2.5-3 turns, but rather take the screw out all together. Use a screwdriver with a magnetic blade for reinstalling the screw during the reassembly because both installation and tightening are inconvenient, and the screw may fall inside the camera.

To remove the front shield *7* (Fig.310), unscrew the exterior chromed screws *5*, *6*, *9*, *10*, *11*, and *12*. Screws *9*, *10*, *11*, and *12* are long, while *5* and *6* are short. Be careful not to confuse them because if the long screws are put in instead of the short ones, the rangefinder compensator will be damaged. Next, pull back the leather corner (Fig.311) and unscrew the shield fastening screw. This screw is inserted in the hole *2*. Gently lift the shield's lower edge to remove it from under the figured cams of the lens barrel, and remove the shield. Memorize the positions of the protective flat-parallel glass of the rangefinder and the spring frames to be able to reinstall them at reassembly.

The removal of the focal plane shutter from the body and its installation are the most crucial steps of the job. Thus, try to do the repair without removing the frame with the shutter.

This is how the shutter is removed. Start by unscrewing the screws *14* and *9* (Fig.309) and screws *3*, *6*, and *8* (Fig.312). Next, unscrew the two screws and remove the shield of the flash synchronization socket (if the camera has it), and detach one end of the wire from the socket. Now it is possible to remove the frame with the shutter from the body. To do that, hold the body and frame as shown in Fig.313 and separate them. Make sure that the brass washer which is installed between the body and the screw of the brake gear *6* (Fig.317a) is not lost. You can now extract the flash synchronization wire from the hole in the camera body.

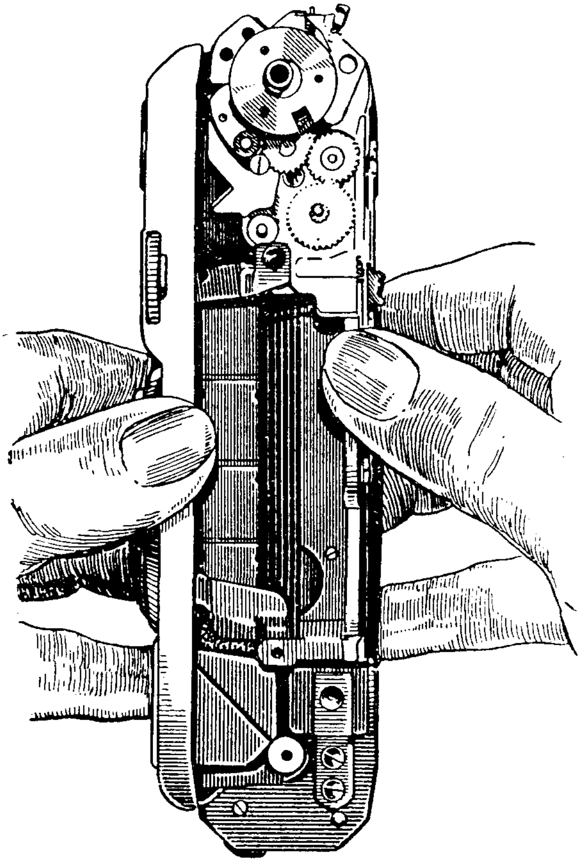


Figure 313. The removal and installation of the shutter.

After removing the shutter from the camera body, immediately insert the M1.7x0.35 screw *2* with a large head (Fig.314) in the hole on the side wall of the shutter body (Fig.314) so that it covers the curtain bushing sleeve shaft *1*. Otherwise, the shaft is likely to fall out, and the setting of gears will be damaged, a condition very difficult to correct. Unscrew the screw when installing the shutter in the camera body. The disassembly sequence for individual parts is discussed in the descriptions of corresponding parts.

The reassembly of the listed parts is done in the reverse order and does not present any problems. Shutter installation is an exception. The shutter is installed in the camera body as follows. Before the reassembly, put a brass washer in the recess *9* (see Fig. 346) and oil it, so that the washer does not fall out during the reassembly. This washer can be installed when assembling as well, but with greater difficulty. Put the end of the flash synchronization wire (if there is one) through the hole and fold it (see Fig.314) to fit it in the shutter frame recess and prevent it from being pinched in the body. Hold the shutter and the body (as shown in Fig. 313) and install the shutter, tilting its upper part toward the body to put the springs *4* and *5* (Fig.312) in place. The spring *5* is located above the shutter frame, and the spring *4* is under the lug *2*. The screw *14* (Fig.309) should be put in first. Check the setting of the shutter frame.

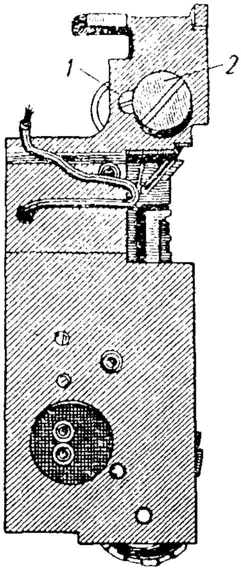


Figure 314. The side of the shutter body.

The shield *4* (see Fig. 317b) is in the front part of the shutter. It has to be set on the barrel *15* worm (see Fig. 346) when the shutter is installed. The setting of the shield *4* (see Fig. 317b) can be checked by putting your finger through the hole for the lens. If the shield is not in place, it can easily be rectified. You should next check the position of the lever which connects the selftimer *1*. Its end should be in front of the pin *12* (see Fig. 346). Lastly, insert the screw *9* (Fig.309) and screws *3*, *6*, and *8* (Fig.312). You ought to check the operation of the shutter without installing the screen, while holding the shutter curtain with the thumb of your left hand to make the curtain slide along the guiding strips *3* and *6* (Fig.320) of the cap peak. After you are through, install the screen *6* (Fig.309), put in its fastening screws, and insert the box screw that is located in the hole *12*. Having made sure that the shutter functions correctly (its adjustment is described on p.257), solder the end of the wire to the flash synchronization socket and install its shield.

Removable Back Cover

The back cover is made of a pliant material and may easily be deformed. With time it bends due to the pressure of the buttons on the camera body. As a result, the movement of the support plate *4* (Fig.315) decreases, and the film is pressed harder than necessary. Remove the support plate and straighten the cover by lightly tapping it with a mallet. If the mallet is not available, you may straighten the cover with your fingers. Make sure that the upper edges of the cover that get into the body grooves are straight. The edges may become deformed as a result of the improper removal of the cover or when the cover has been dropped. If this should happen, the edges can be straightened with pliers.

The bracket with the roller *3* guides and controls the film movement. The roller has to rotate freely. The roller bracket bends when the cover is deformed and hinders the film movement. Therefore, the bracket has to be straightened along with the cover. Over a long period of camera operation, the roller shafts deteriorate and fall out. To replace them, drill a hole, 1 mm in diameter and 3-4 mm deep, in the roller butt-end and tightly insert a piece of steel wire, or else cut an M1.2x0.25 or M1.4x0.25 thread, insert the screw and cut it to fit the hole in the bracket. The tripod nut *1* is fastened with four screws from the inside. If the screws are loosened, the nut, too, becomes loose. Thus, the screws should be periodically retightened.

A post is secured on the tripod nut to stabilize the camera. It is fastened with two ledged screws which should be periodically retightened as well.

The support plate *4* is fastened with the springs to the back cover. It presses the film against the frame window to prevent the film from warping. The support plate is polished and oxidized. It must not have any scratches because they would scratch the film. If the rivets fastening the support plate to the springs fall out, put new ones in carefully to avoid deforming or scratching the plate.

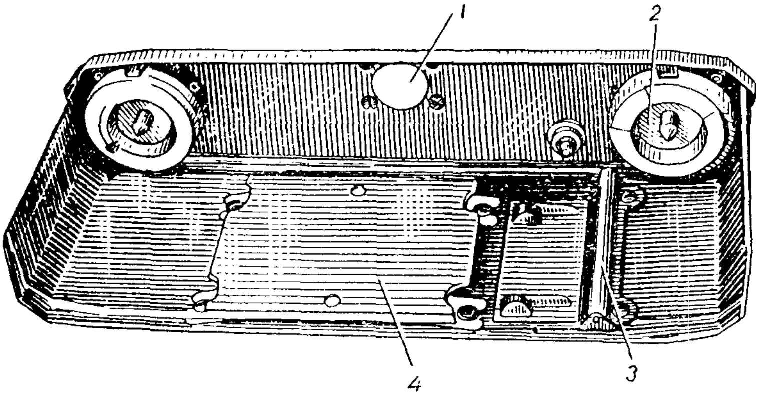


Figure 315. The removable back cover.

The back cover has two locks for locking the cover on the body and also for opening and closing the two-cylinder cartridges.

The lock (Fig.316) consists of the steel washer *1*, lock plate *2*, spring washer *3*, chromed washer *4*, cap *5*, handle *6*, and pin *7*.

The lock is assembled in the following order. Install the washer *1* from the inside of the cover and insert the lock plate *2*. Then turn the cover upside down and hold the lock plate *2* in your left hand. Using your right hand, put the spring washer *3* in the lock recess on the outside of the cover along with the chromed washer *4*, cap *5*, and handle *6*, and fasten the whole lock with the pin *7*. To install the pin use pliers (see Fig. 244) that have an inserted piece of foil to prevent scratching of the chrome coating of the cover.

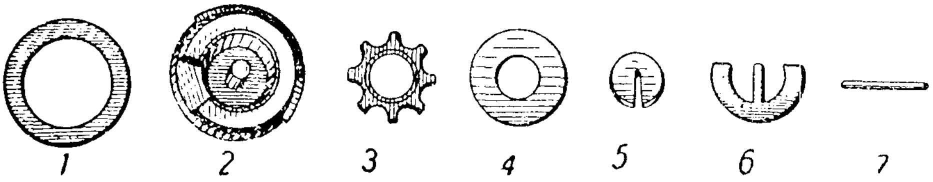


Figure 316. The parts of the cover lock.

All the parts in both locks are the same, except for the lock plate. The shape of the lock plate for the cartridge differs from the shape of the lock plate for the spool. The damage mostly occurs in the lock plate for the cartridge due to defective cartridges. The cartridges for the "Kiev" camera should be carefully selected which is true of every 35 mm camera.. The two-cylinder split cartridges made of zinc that are being marketed do not always fit the camera. Therefore, when choosing a cartridge, always check whether the cartridge fits the particular camera.

Focal Plane Shutter

The focal plane shutter in the "Kiev-2" camera (Fig.317) is one of the most complex shutters. Before giving its description, it is necessary to discuss the function of the winding mechanism which drives the focal plane shutter, the speed mechanism, the film transport mechanism, the exposure counter, and the brake device. It is impossible to study the winding mechanism separately from the mechanisms listed above, just as it is impossible to study those

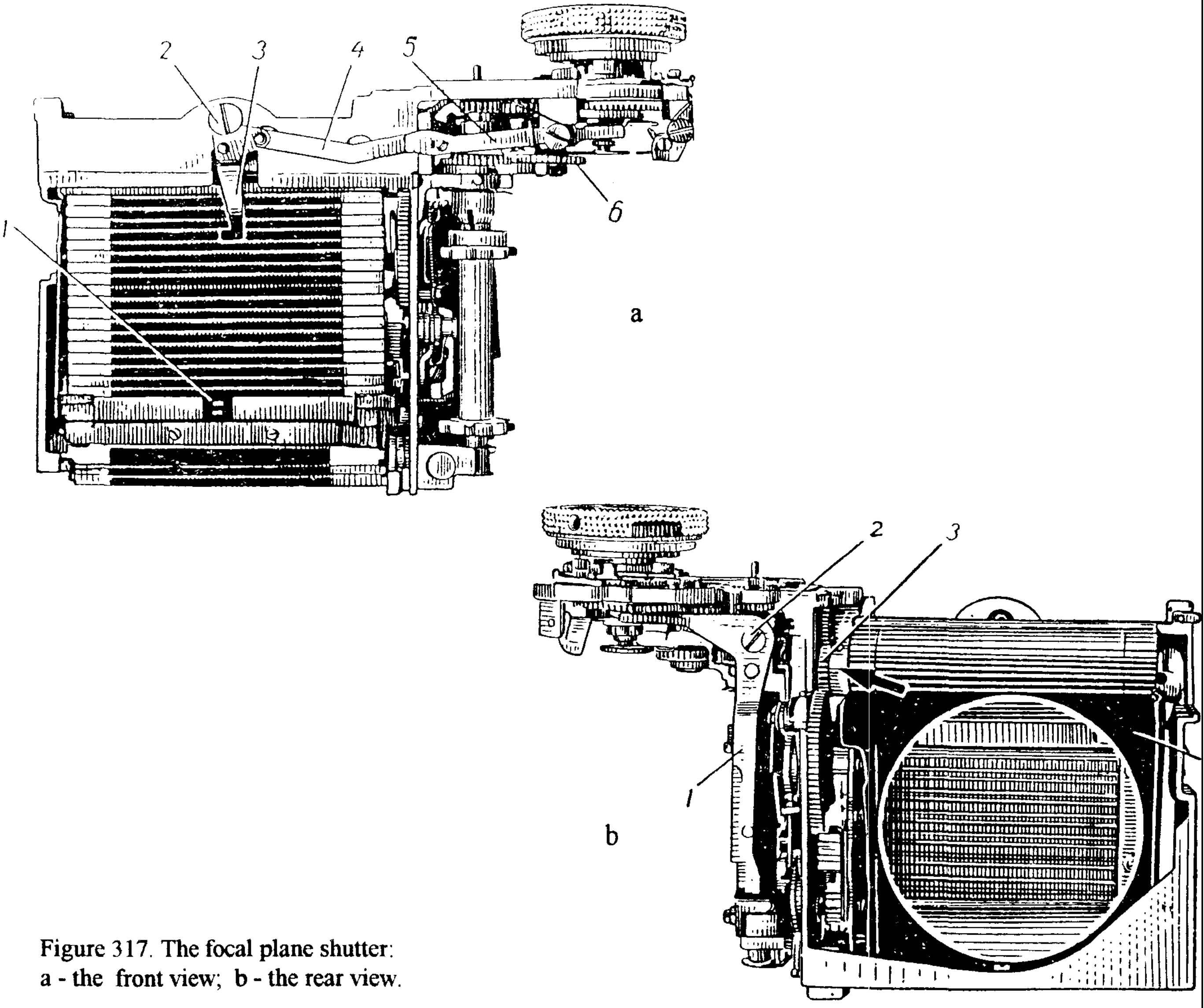


Figure 317. The focal plane shutter:
a - the front view; b - the rear view.

mechanisms separately from the winding mechanism. Besides, the focal plane shutter, the speed mechanism, the film transport mechanism, the exposure counter, the brake device, and some other assemblies pertaining to the shutter are mounted on one frame (the shutter body).

Design and operational principle. The shutter curtains consist of hinged metal plates whose edges are joined by a narrow leather strip. The curtains are connected by two ribbons and are attached to the bushing sleeves. The whole curtain assembly is shown in Fig.318.

Since in the "Kiev" camera the curtains move in the vertical direction, let us consider the curtain *2* (Fig.318a) to be the upper curtain and the curtain 14 to be the lower one and, respectively, the bushing sleeve *4* as the upper bushing sleeve and the bushing sleeve *12* as the lower one. The screws *5* and *6* connect the upper bushing sleeve *4* to the journal of the gear *7* shaft. The Figure 317b shows this gear in its interaction with the winding mechanism gear. The bushing with the hole *3* is located on the left side of the bushing sleeve. The shaft of the bushing sleeve runs through the hole *3* and the one in the center of the gear *7*. It is installed during the assembly of the curtains in the shutter body (see details below).

The lower curtain *14* is attached to the bushing sleeve *12* that has three figured spiral springs inside it: two on the sides and one in the middle. The side springs are attached to the rollers *9* and *13* with one end and to the shaft *8* with the other. When the mechanism is wound, these springs reel the ribbon around the rollers and drive the upper curtain of shutter. The middle spring is fastened with a bushing to the bushing sleeve *12*; its other end is attached to the shaft *8*. It drives the lower curtain. Thus, all three springs are attached to the shaft *8* and are wound by the rotation of this shaft. The lower curtain's bending enters the bushing sleeve groove and is supported by the spring *11* to avoid displacement. The ends of the spring *11* are located under the leather label *10*. The leather is glued for correct reeling of the lower curtain around the bushing sleeve. This entire part is called the lower curtain roller and is a very complex assembly. It is not recommended to disassemble it.

The lath *19* is attached to the upper end of the lower curtain while its bending *15* restricts the curtain's movement when the shutter is in a wound position. The bending *15* also turns the lever *3* (Fig.331), and closes the flash synchronization electric circuit. The screws *17* and *18* (Fig.318a) fasten the friction spring *16* to the lath; the spring's pins *21* and *22* (Fig.318b) get into the holes *1* (Fig.318a) and connect the upper and lower curtains. The friction clutches *20* and *23* (Fig.318b) are located on the lower side of the lath. The ribbons run through these friction clutches.

Both curtains are connected by two ribbons whose upper ends are sewn to the edges of the upper curtain and lower ends are sewn to the rollers of the lower curtain.

Having discussed the design of the curtain assembly, let us consider the design of the winding and speed mechanisms. Note the position of the gear *3* (Fig.317b). The winding mechanism is at an angle to the left of it, and the speed mechanism is below it. The gear acts as an intermediate link between them.

Winding mechanism. The shutter is wound with the knob *1* (Fig.319a) which makes one turn during the winding. Its movement, and the winding mechanism's movement along with it, is restricted on one side by the lever *12* whose shoulder gets into a recess on the speed ring *3* during the winding of the shutter and restricts further winding. On the other side it is restricted by the lever *3* (Fig.319b) whose tooth gets into a hole on the speed ring. Thus, both levers fix the mechanism in the wound position.

To prevent reverse mechanism movement during the winding of the shutter (all the gears rotate freely), the brake mechanism is installed. This mechanism consists of the gear *11* (Fig.319a) and the disk with two bendings. When the gear rotates clockwise during the winding, the disk's bending is at a certain distance from the teeth of the gear *11*. When the gear starts to turn in the opposite direction, the bending gets between the gear teeth and stops its movement.

The winding knob activates the film transport mechanism. The film always advances the same distance and always makes a full turn during the winding, while the winding gear *9* (to which it is connected; see Fig.319a) turns only at a certain angle which depends on how the shutter speed is set. The beginning of the motion of the winding gear *9* is dependent on the set speed as well.

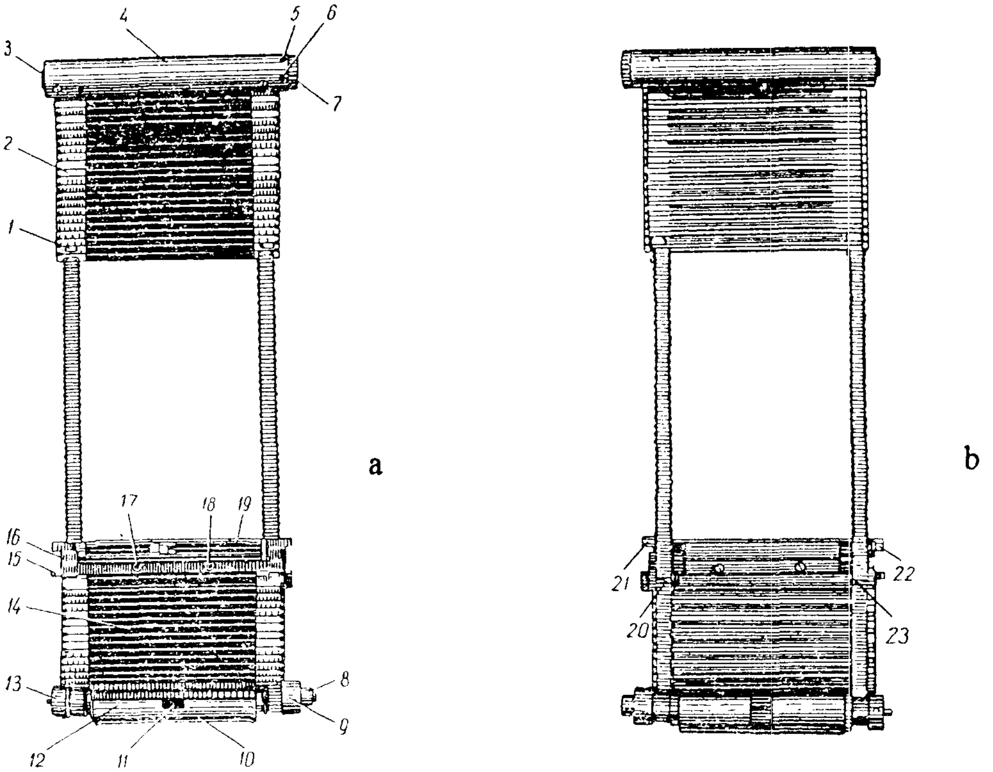


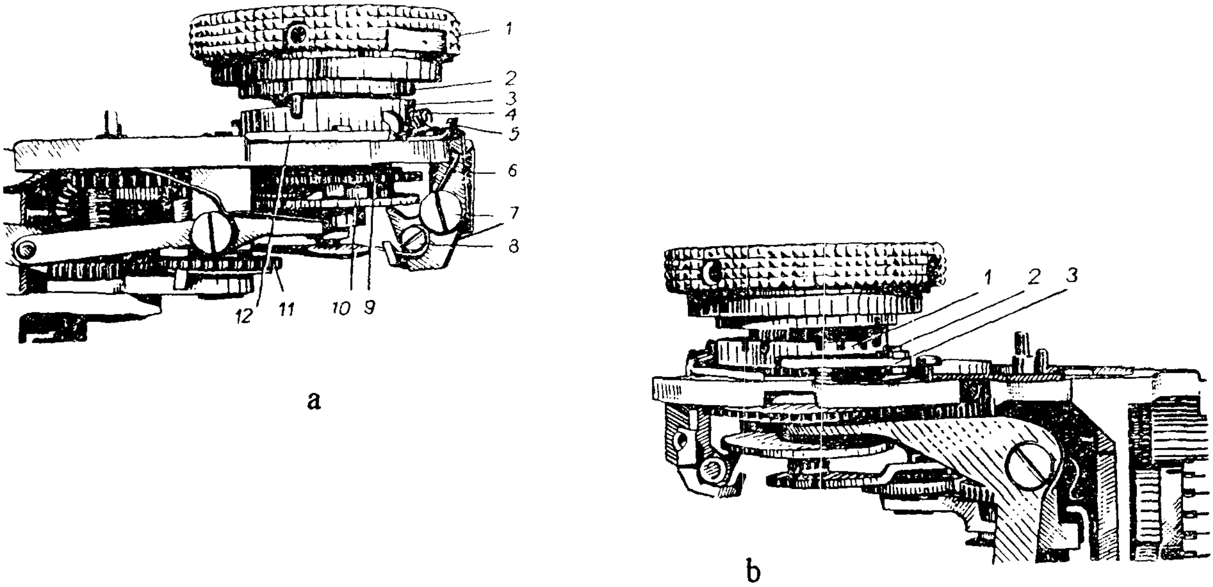
Figure 318. The assembly of curtains:
a - the front view; b - the rear view.

The winding knob is fastened with three screws to the disk *2* whose shaft journal is connected with the shaft journal of the lower disk *10* through a special device (the shaft journal of the lower disk is also the shutter's release shaft). The lower disk *10* makes a full turn when the winding knob turns. The lower disk has a lock which consists of two pins - the front one beveled and the back one straight. The winding gear has one pin. The lower disk rotates during the winding of the shutter. Its lock reaches the gear pin, catches it, and, as a result, the winding gear starts rotating.

The gear pin gets into the disk's lock easily because it slides along its front beveled pin, lowers the disk, and gets between the pins. The disk is driven by a spiral spring which is located inside the mechanism. The pin cannot get out of the lock until the release shaft is depressed and the pins are separated.

Prior to the winding of the mechanism, the winding gear pin is always in one certain place, and the position of the disk and its pins depends on the set speed. Therefore, depending on the set speed, the disk pins sooner or later catch the gear pin and rotate the winding gear for a certain period of time. The winding gear is connected with the gear of the upper curtain bushing sleeve through a whole system of gears. When the shutter is wound, the upper curtain reels around the upper bushing sleeve, and the lower curtain reels off the lower bushing sleeve. For some time, both curtains move together, connected to each other by the friction spring pins. However, when the curtains reach a certain point, the pins are lifted by a special device, and the curtains separate. At the same time, the lower curtain stops, and the upper curtain keeps reeling around the bushing sleeve. The width of the slit between the curtains depends on the set speed.

The curtains move along the guiding strips *3* and *6* (Fig.320) on the shield. The shield is shown separately on Figure 321a,b. The guiding strips on the shield and the guiding strips on the inside of the screen *6* (see Fig. 309) on the other side limit the sagging of the curtains and guide their movement.



a

b

Figure 319. The winding mechanism:
a - the front view; b - the rear view.

During the winding of the shutter, the curtains move side by side for some time, and then their locks become disengaged and the lower curtain stops. The shoulder *4* on the lever *2* (Fig.320) causes their disengagement; another such shoulder - shoulder *5* - is located on the lever *1* (Fig.321b). When the curtain locks *1* and *7* (Fig.320) of the friction spring reach these shoulders, they move up, and the pins on the locks leave the holes *1* (Fig.318a). After this the curtains separate.

The figured shield protects the shutter gears from dust and pieces of film. The shield is fastened with four screws - two on top and two on the base. Remove the shield with care so as to avoid deformation of the lever *1* (Fig.321a). The bushing sleeve has a special groove to help you remove the shield (see arrow in Fig. 317b).

Shutter speeds. The speed mechanism is the most complex part of the camera. The adjustment of each shutter speed has its characteristics and is done independently. It may so happen that some speeds function correctly and others do not. Sometimes all the speeds work properly except for one, or vice versa. It is difficult to determine the exact exposure time, but practically speaking most photographers notice when the speed is incorrect right away. Knowing the shutter design, it is even possible to tell most of the speeds by ear.

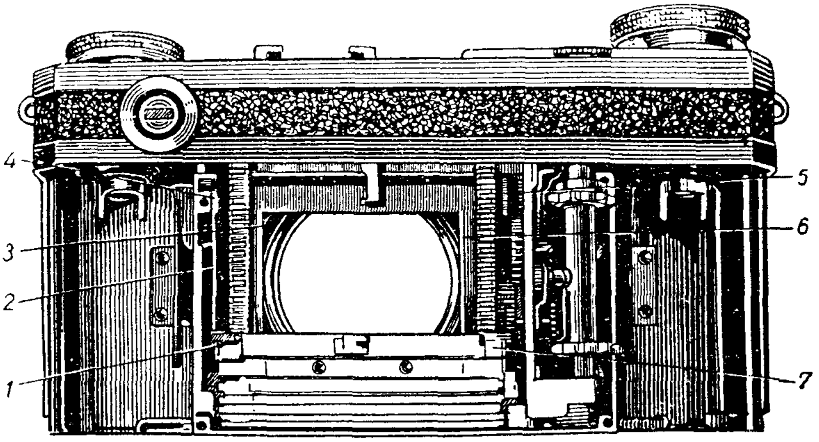


Figure 320. The shutter in the open state.

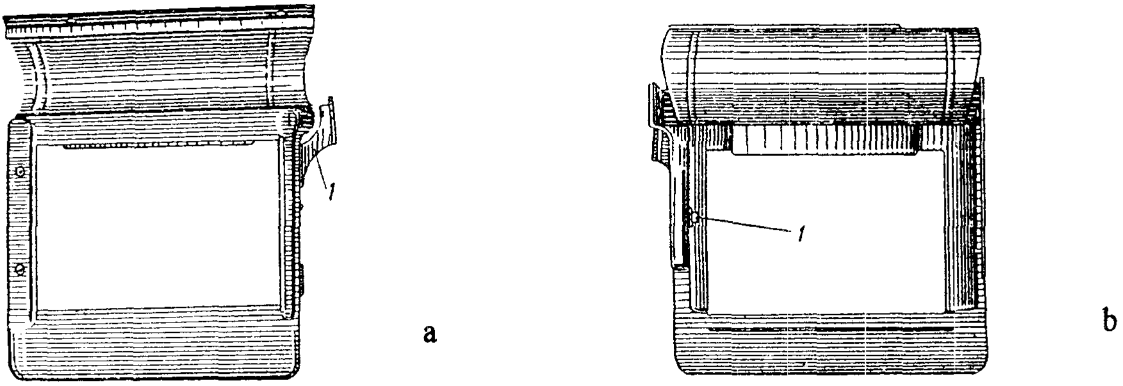


Figure 321. The shutter cap peak:
a - the front view; b - the rear view.

The speed is controlled by two delay mechanisms and by the width of the slit formed between the curtains. The longer the exposure time, the more the curtain reels around the bushing sleeve and, consequently, the wider is the slit between the curtains. Two pallets work at the "B" and the 1/2 sec speeds (you can easily hear their jingling); one pallet works at the 1/5, 1/10, 1/25, and 1/50 sec speeds. Both pallets are disengaged at any other speeds, and the exposure time depends only on the slit width.

The operation of the shutter speed mechanism consists of switching the pallets on and off at the particular speed setting.

The shutter speeds are set as follows. There is a pin on the bottom side of the winding knob (see arrow in Fig. 322), and the number of grooves in the disk *1* (Fig.319b) is equal to the number of speeds. When one speed or another is set, the pin on the knob sets into the corresponding disk grooves.

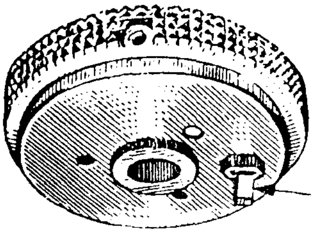


Figure 322. The winding knob.

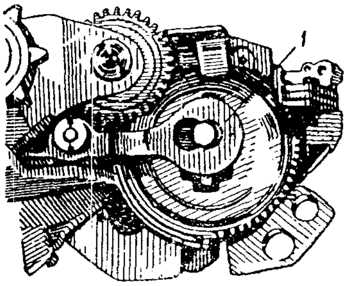


Figure 323. The lower side of the winding mechanism.

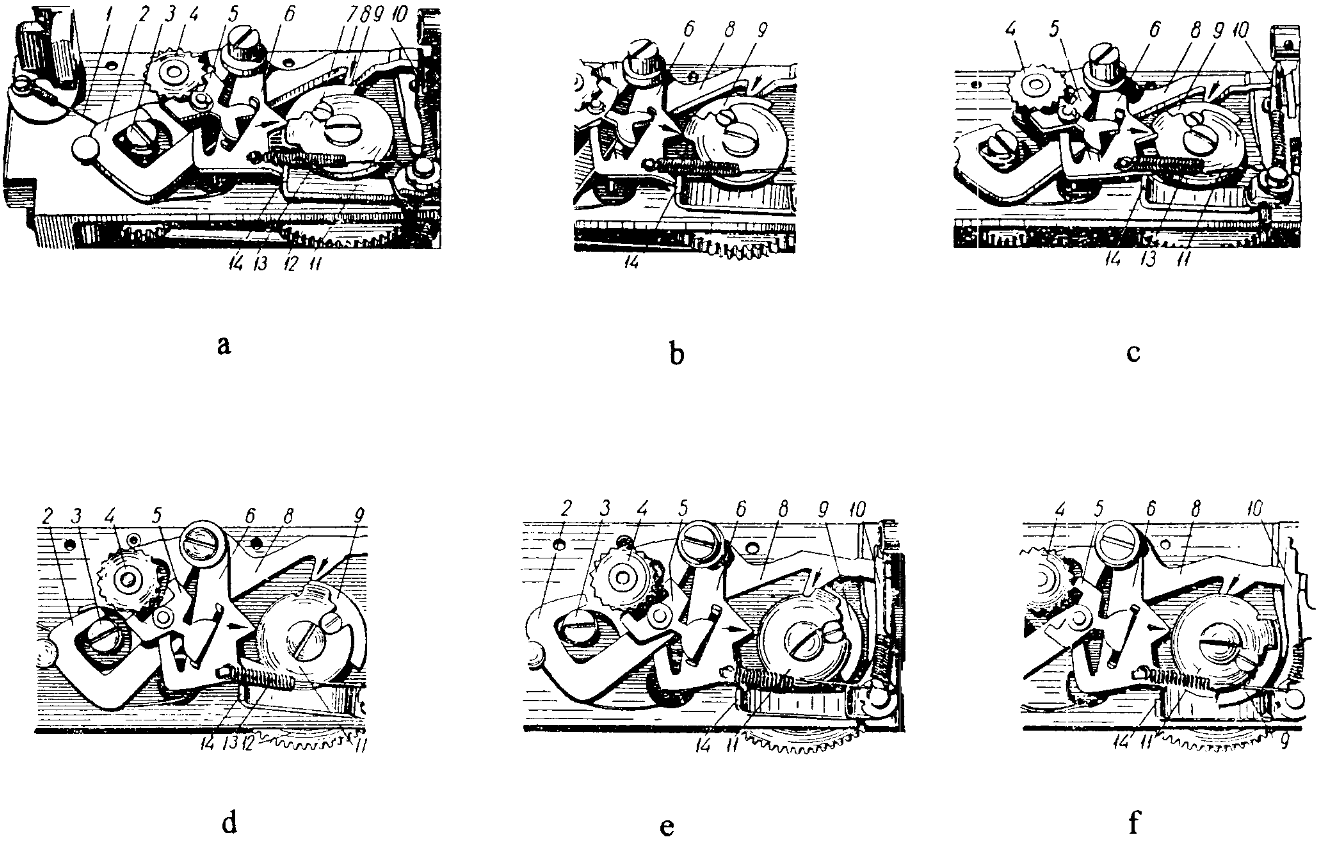
The knob also has to be lifted to set the speed (if the speed is not repeated). At this time, the lever *1* (Fig.323) turns; it is connected with the upper disk bearing the winding knob. In turning, the lever *1* shifts out and turns the lever *10* (Fig.324).

During the winding of the shutter, the gear *3* (Fig.317b) turns the gear *12* (Fig.324a) that makes an almost complete turn at the "B" speed; its turn decreases accordingly at other speeds. The gear *12* shaft bears two disks with segment-shaped cams that control the switching of the pallets. Figure 324a shows the positions of the disks *9* and *11* during the setting of the "B" speed. The lever *8* tooth (see arrow) is located on the right edge of the disk *9* cam's surface. In this position, the lever's *8* arm *2* pushes the cam screw *3* and turns the lower pallet mechanism (see Fig. 325a) which involves the pallet and all the mechanism gears in operation. During the operation of the focal plane shutter, the disks *9* and *11* rotate, the lever *8* tooth gets off the cam, and the lever can fall if its end does not rest against the top step of the three-step lever *10*.

At the same time, the lever *6* tooth (see arrow) bearing the pallet *5* rests against the cam, turns the lever, and presses the pallet *5* against the escape wheel *4*, i.e., involves the second pallet mechanism in operation. The lever *6* arm rests against the lever *14* shoulder to make the lever stay in place when the cam *11* turns.

To get the "B" speed, a disk with a tooth (not shown in Fig. 319a) is installed above the gear *9*. When the release button is depressed, the disk *10* goes down, and presses and turns the lever *6*. At the same time, the lower curtain returns to its starting position and opens the frame window, while the upper curtain is hampered in its movement because when the lever *6* turns, it catches the disk tooth and stops the gear.

Figure 324b shows the positions of the parts at the setting of the 1/2 sec speed. The cams *9* and *11* are somewhat shifted, but the lever *8* teeth and the lever *6* remain on their surfaces. All other levers and pallets operate the same way as at the "B" speed, but the slit between the curtains is slightly narrower, and the lever *6* (Fig.319a) does not catch the disk tooth.



a b c

d e f

Figure 324. The upper parts of the speed mechanism at speed setting:
a - "B"; b - 1/2 sec; c - 1/5 sec; d - 1/10 sec; e - 1/25 sec; f - 1/125 sec.

The Figure 324c shows the positions of the parts at the setting of the 1/5 sec speed. The lever *8* tooth is on the surface of the cam *9*, and the lower pallet mechanism remains switched on, but the lever *6* tooth is next to the cam *11* and not on it. At this time the lever driven by the spring *13* turns and switches off the pallet *5*. The Figure 324c shows that the pallet is located far from the escape wheel. Just one lower pallet works at 1/5 sec speed.

The Figure 324d shows the positions of the parts at the setting of the 1/10 sec speed. The positions of the levers and pallets are the same as at the 1/5 sec speed, but the slit between the curtains is narrower, and the exposure time is correspondingly less.

The positions of the parts of the speed mechanism's lower half (Fig.325a) at the "B", 1/2, 1/5, and 1/10 sec speeds remain the same because the lever *8* (Fig.324a) is on the top step of the lever *10*, and the cam screw *3* (Fig.325a) is located next to the lever *2*.

The Figure 324e shows the positions of the parts at the setting of the 1/25 sec speed. The lever lowers to the second step of the lever *10*, and its tooth goes to the second smaller circle of the disk *11*. The lever's *8* arm *2* releases the screw *3* which is driven by the spring *1* (Fig.324a) to a new position and by doing this turns the lower pallet mechanism. In this state, the upper pallet is switched off, and the lower pallet is switched on. However, the interaction between the gears of the lower pallet mechanism (see Fig. 325b) and the escape wheel can be changed by turning the lower pallet mechanism. The escape wheel in the *a* position (Fig.325) is the fifth in the chain of mechanism working gears while it is the second in the *b* position. It also controls the shutter speeds.

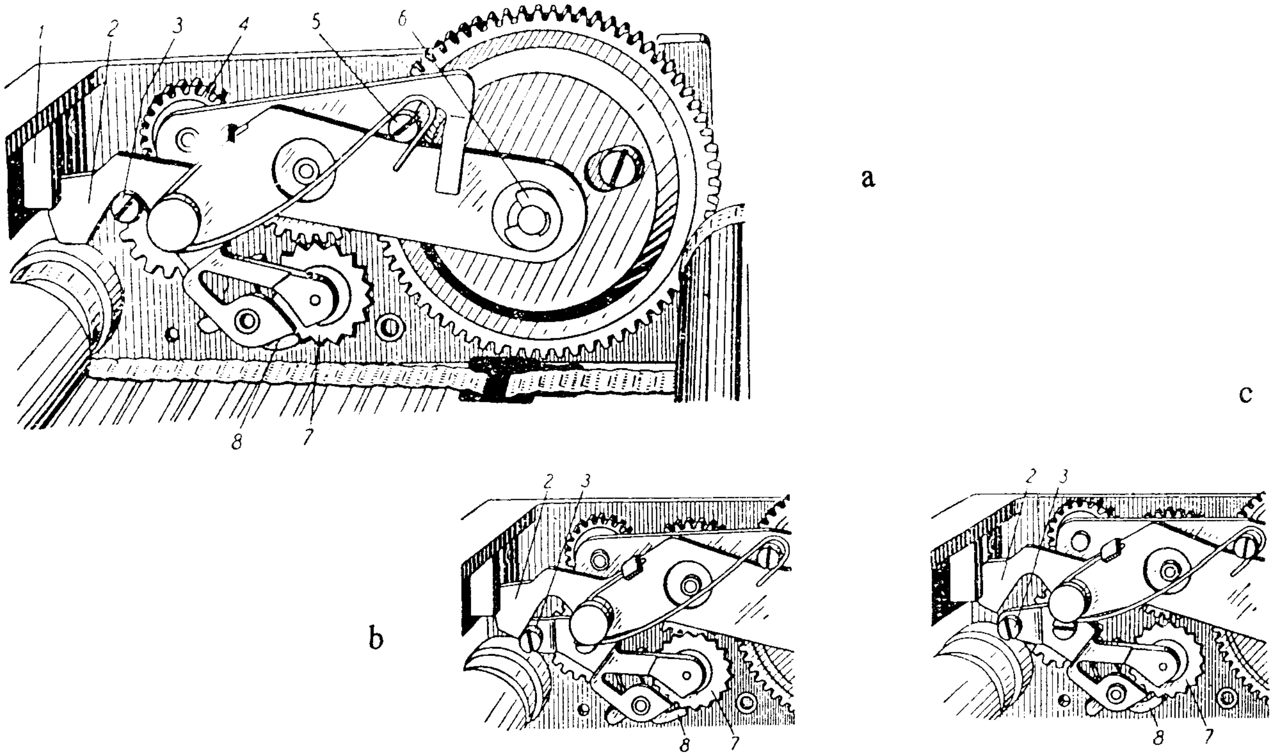


Figure 325. The lower parts of the speed mechanism at speed setting:
a - "B", 1/2, 1/5, 1/10 sec; b - 1/25, 1/50 sec; c - 1/125, 1/250, 1/500, 1/1250 sec.

The positions of the levers and pallets are the same as at the 1/50 sec speed, but the slit becomes narrower.

The Figure 324f shows the positions of the parts at the setting of the 1/125 sec speed. The lever *8* arm sets on the third step of the lever *10*, and a new part becomes involved in the operation. This is the lever *10* arm that elevates the lever *2* (Fig.325c) and breaks its connection with the escape wheel. Thus, both pallets are switched off at the 1/125 sec speed and all the consecutive speeds, and the speed is controlled by the slit width.

The interaction of the parts and gears of the speed mechanism is adjusted using the cam screws *3* and *7* (Fig.324a) along with the screws *3* and *5* (Fig.325a). This procedure is complicated and requires special skills. It is very rarely done in camera repair.

Shutter disassembly is done for the cleaning of the shutter, when the ribbon is broken, and in other very rare instances.

The most complicated step in assembling the shutter is the installation (dragging) of the curtain unit. To install the upper curtain bushing sleeve correctly, set the 1/10 sec speed and turn the winding knob all the way as you do when winding the shutter. Then turn the gear *12* (Fig.324a) and install the speed mechanism parts as shown in Figure 324d. Next, hold the gear *12* (Fig.324a) with the thumb of your left hand and install the curtain bushing sleeve with your right hand. Before installing the bushing sleeve, reel the upper curtain around it (see Fig.326), making two almost complete turns (short of 3-4 curtain slats). This is how the procedure is done at the manufacturing site.

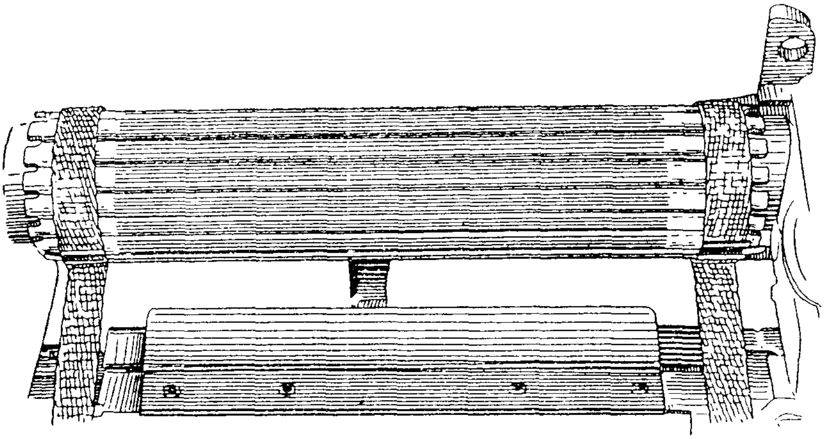


Figure 326. The position of the upper curtain at the assembly of the shutter.

The author of this book performs this procedure slightly differently. He sets the 1/1250 sec speed and turns the winding knob all the way. The curtain is reeled around the bushing sleeve and set in a way that allows 6-7 teeth to be between the beginning of the cut in the gear *1* (Fig.327) and the gear *2* teeth, and no more than 1.5-2 curtain slats to be between the end of the curtain (see Fig. 328) and the shutter body panel.

The winding of the springs in the lower bushing sleeve and the adjustment of the curtains are both discussed below in item 1.

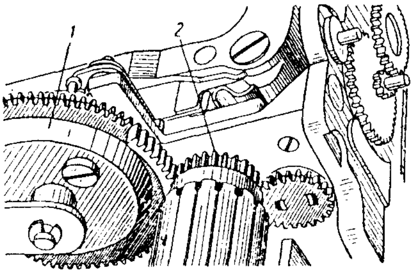


Figure 327. The mechanism parts when the shutter is assembled.

Shutter malfunctions and their elimination. 1. ***The curtain ribbon has broken.*** The ribbon breaks as a result of natural wear and tear because it rubs against the friction clutch lath *20* (Fig.318b). It is very easy to discover a broken ribbon. If the curtains stop moving or warp, look inside the screen *6* (Fig.309) hole without disassembling the camera; the ribbons can be seen on its sides. It is unusual for both of them to break at the same time.

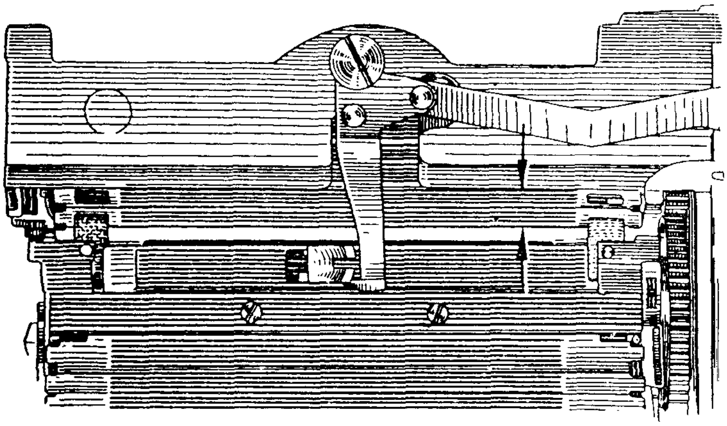


Figure 328. The slit between the curtains when the shutter is assembled.

Only a special ribbon can be installed because it has to be a certain width and thickness.

To install the ribbon, disassemble the camera and remove the focal plane shutter because the ribbon's replacement requires shutter adjustment and mechanism cleaning (pieces of ribbon may have gotten stuck in the mechanism gears). However, considering the complexity of the shutter disassembly, the ribbon can be replaced in most cases with partial disassembly.

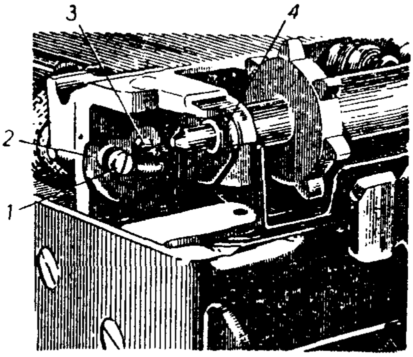


Figure 329. The curtain roller lock.

The removal of the screen *6* (Fig.309) was discussed in detail earlier. After it has been done, remove the box *4* (Fig.329) and loosen the screw *1*, turning it 1-1.5 times. Then hold down the roller of the lower bushing sleeve with your left hand and turn the lock *2* with your right hand to release the stretched springs. While pressing the roller shaft on the left side, shift the roller slightly to the right to get the left side of the shaft out of the socket in the shutter body. If this attempt fails, unscrew the screw *1* and take out the lock *2*. While you are unscrewing the screw *1*, the end of the spring *1* (Fig.324a) may become detached from the screw *3*. This would make it necessary to disassemble the camera completely. Therefore, try to make sure that this does not happen. Keep in mind that there is a brass bushing on the shaft under the lock *2* (Fig.329) which has to be removed and reinstalled when reassembling. Release the left end of the shaft and remove the roller. As you push the shutter release button, pull the curtains all the way down, remove the broken ribbon, and start installing the new one.

First, push the end of the ribbon through the slots in the roller *13* (see Fig. 318a) and sew it with a thin thread. When installing a new ribbon, compare its every position with the position of the other intact ribbon. Then run the ribbon through the friction clutch *20* (see Fig. 318b) and the hole in the upper curtain, fold its tail, and sew it on. The ribbon is sewn on as follows. First, make one stitch from the edge to the middle of the ribbon - points *A-O* (Fig.330), make two stitches *O-B*, one stitch *O-C*, one more stitch *A-O*, and tie the thread into a neat knot.

The ribbon being installed should have the same length as the other undamaged ribbon. Apply some glue to the end of the ribbon to prevent splitting. Then install the roller in its place. There are usually washers by the ends of the roller on the shafts that serve for adjusting the curtain's position. These washers should be installed at reassembly. After that, put on the brass bushing and install the lock *2* (Fig.329). Do not tighten the screw *1*. Insert a thin screwdriver in the shaft *3* slot and wind the curtain springs by 8-10 counter-clockwise turns of the screwdriver (curtain tension should be approximately 160 g). Then turn the lock to fix the shaft and tighten the screw.

Now wind the shutter a few times and check the operation of the curtains. While doing this, lightly hold down the lower curtain with the thumb of your left hand to imitate the function of the screen.

When removing the screen, brush the dust from the shutter parts and lubricate the rubbing surfaces of the shafts with watch oil.

Some other steps of the curtain adjustment are discussed in the following items.

2. ***Slow movement of the curtains.*** This malfunction results from a dirty mechanism, as well as a thickened and dried out lubricant.

Clean and oil the focal plane shutter. Examine the pallet speed mechanisms (see Fig. 324, 325) with particular attention. Set the "B" speed and rotate the gear *4* (Fig.325a) with your finger when the shutter is released. All the mechanism gears should rotate freely and easily. If they do not, brush the assembled mechanism in benzine or, better yet, spray it with benzine from a rubber bulb. Then lightly oil the gear shafts and check the operation of the shutter. The winding mechanism (see Fig. 319a,b) is seldom cleaned.

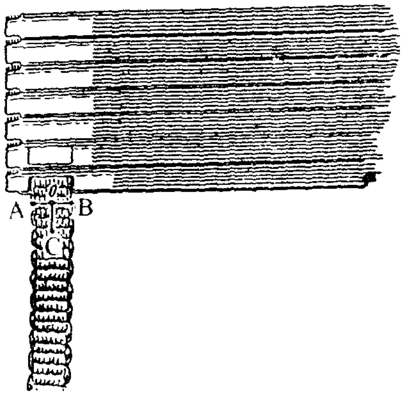


Figure 330. The ribbon fastening.

Sometimes cleaning requires the removal of the lever *2* (Fig.325a). In that case, unscrew the screw and remove the bushing *1*. Take out the fastening washer *6* and the lever.

3. ***The shutter curtains do not move.*** Sometimes the shutter curtains cannot be wound at all or they are wound but will not move after the release button is pushed. This is caused by a

dirty mechanism and, particularly, by sand particles in the mechanism. Therefore, it is not recommended to take the camera out of its case and reload the film at the beach or in the field. The mechanism is cleaned as described above.

4. ***The winding knob turns, but the shutter cannot be wound.*** In this case, it is impossible to set the needed speed because the knob cannot be fixed opposite the line with the numbers. Check whether the setting pin on the bottom side of the winding knob is intact because sometimes its tip breaks off (see arrow in Fig. 322). In that case you will have to drill out the broken pin, make a new one and install it on the winding knob. The length of the broken part of the pin is usually about 2.2 mm.

A similar malfunction occurs if the selftimer mechanism is stopped while it is still working. In that case, the connecting lever *1* (Fig.317b) shifts out the disk *10* (Fig.319a) whose pins cannot catch the winding gear pin. To correct it, wind the selftimer and check its operation.

5. ***After it is wound, the winding knob does not stay still but slightly turns in the opposite direction.*** The shutter mechanism is fixed in the wound position by the lever *3* (Fig.319b) that turns on the cam pin *2* serving as a shaft for it. When the lever does not work, it appears that the knob does not stay still but slightly turns in the opposite direction if the shutter is wound and the winding knob is pushed down. If the "B" speed is set, the 1/5 sec speed will trip instead of the "B" speed at the push of the release button. To understand the reason for this malfunction, remove the top plate *11* (Fig.308), install the winding knob without the top plate, and watch the operation of the stopping lever during the winding. If the lever shaft was exposed to moisture, remove the lever, and clean and oil the shaft. If the lever spring is weak, bend it.

The lever may not move because the top plate is set too low and catches it. In this case, slightly clean the spot on the plate where the lever is located.

6. ***The curtains separate arbitrarily when the shutter is being wound.*** During the winding of the shutter, the upper curtain goes up and pulls along the lower curtain connected with it by the friction spring *16* (Fig.318a). The slightest deformation of the friction spring as well as wearing out of the locks may cause poor curtain coupling. Thus, the lower curtain stops, and the upper curtain keeps moving up.

To correct the problem, remove the screen and check whether the friction spring locks *21* and *22* (Fig.318b) are flexible enough. To strengthen the spring, remove it and slightly bend it in the middle. The spring is fastened with two screws that should be carefully unscrewed to avoid curtain lath deformation. There is a washer under the spring; do not forget to reinstall it. If this does not help, try slightly sharpening the spring locks. The locks are actually two pins (one on each side) with a beveled front that allow the upper curtain to pass freely through the slot of the lower curtain lath; the pin backs are at a right angle. The right angle should be carefully filed.

If the locks separate poorly during the adjustment of the shutter, slightly bend the shoulder *4* (Fig.320) upward, using one hand, and shift the lever *5* up with the other. To do this, loosen the screw *1* (Fig.321b) by a half-turn, shift the lever, and tighten the screw.

7. ***The winding of the shutter is not restricted, and the necessary speed cannot be set.*** At the winding of the shutter, the lever *12* (Fig.319a) shoulder gets into the recess on the ring *3* and restricts its further winding. If the lever does not restrict the winding, the necessary speed cannot be set. To correct the problem, remove the top plate *11* (Fig.308) and adjust the lever's position. First, check whether the spring *4* (Fig.319a) is in place because sometimes the spring *5*

holder turns, and the spring stops functioning. Put the holder back in place and tighten the screw fastening it.

The position of the lever *6* is adjusted by slightly turning the cam screw *8*. This increases or decreases the tilt of the lever *6* which turns the lever *12*. Adjust the lever *6* so that the lever would leave the groove on the ring *3* a little earlier than the shutter trips when the release button is slowly depressed.

8. ***The shutter can be wound only after the release button is pressed harder several times.*** This malfunction is caused by the misadjustment of the lever *12* (Fig.319a). (See details in Malfunction 7). When adjusting the lever *12*, keep in mind that the lever should not only fall into the groove on the ring *3* on time but leave it on time as well.

9. ***The curtain falls arbitrarily.*** Sometimes the lower curtain arbitrarily goes down after the winding of the shutter. This happens more often when the winding knob is switched from one speed to another.

During the winding of the shutter, the lower curtain in fixed in the wound state by the spring lever *3* (Fig.317a) that catches the lower hook *1* installed on the curtain lath. When the release button is pushed, the lever *5* turns the lever *4* which turns the lever *3*, and the curtain is released. This happens a moment before the disk *10* (Fig.319a) pins release the winding gear *9*.

If the spring lever *3* (Fig.317a) does not catch the hook *1* at all or holds it poorly, the curtain may arbitrarily return to its starting position. However, the ribbon running through the curtain friction clutches slows it down somewhat. This malfunction is indicated by the fogged parts of the pictures. The fog does not have to appear on all subsequent pictures.

The problem is eliminated by the adjustment of the lever *3*. The lever *3* is adjusted by turning the cam screw *2* that serves as its shaft or by slightly bending the lever *5*.

10. ***The "B" speed does not work.*** Sometimes all the speeds work correctly except for the "B" speed.

The shaft *7* (Fig.319a) supports three levers that turn when the release button is pushed. The lever *6* is auxiliary and serves for adjusting the lever *12* (it was mentioned in Malfunction 7). The third, lower lever (not shown in the Figure) detains the "B" speed ring while turning. If the "B" speed does not work, check whether the levers turn, and oil their shafts. Then check whether the lever's tooth reaches the ring's tooth. If it does not, remove the lever, put it on a hard surface and slightly hammer the lever tooth.

The "B" speed also may not work for the reason discussed in Malfunction 5.

Flash Synchronization Mechanism

In the "Kiev" camera, the closing of the flash synchronization electric circuit occurs at all speeds, but the pulsed flash should not be used at speeds faster than 1/25 sec.

The flash synchronization mechanism consists of a socket installed on the front wall of the camera body, a contact mechanism (Fig.331) consisting of the insulated base *6* and two contact springs *7* and *8* located on the shutter body, the lever *3* closing the contact springs, and the wire *5* connecting the socket and the contact mechanism.

Flash synchronization mechanism's operational principle. The lower curtain *1* pulled all the way down by the lath bending *2* presses the lever *3* arm and turns it. Simultaneously, the lever's second arm presses the upper contact spring *8* and closes the electric circuit and the lower insulated spring *7*. The lower spring is wired to the interior insulated contact of the socket.

Flash synchronization mechanism's malfunctions. 1. ***A broken electric circuit.*** This problem is often caused by the wire being poorly soldered to the socket. Remove the shield covering the socket and check the joint.

Besides that, the electric circuit may remain open as a result of burned contacts secured on the springs *7* and *8*. To correct the problem, disassemble the camera, take out the shutter and clean the surface of the silver contacts with a sharp tool. It can also be done without disassembly by removing the screen *6* (Fig.309) gently to avoid damaging the contact springs.

2. ***The electric circuit closes too soon.*** Sometimes, when operating the camera with a pulsed flash, part of the frame, approximately 2-3 mm from the edge, remains unexposed. The electric circuit should close at the moment when the shutter is completely open. If part of the frame is not exposed, it means that the flash switched on before or after the frame window became fully open. Placing the film in the same position as during the shooting (the image in the frame window is flipped) allows you to determine whether the flash went off too early or too late.

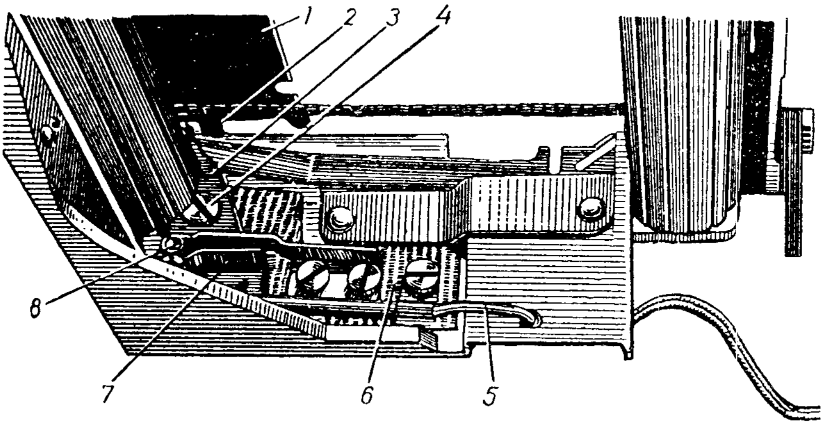


Figure 331. The contact mechanism.

Elimination of this problem requires partial camera disassembly. Remove the screen *6* (Fig.309). It is easy to find the lever *3* (Fig.331) and the contact springs *7* and *8* when the shutter is wound. If the flash turns on too early, bend the lower spring *7* slightly downward; if it turns on too late, bend the spring upward. This is done using a thin screwdriver or needle. Then press the lever *3* with your finger to check whether the contacts close. The flash synchronization operation is checked only during the shooting. If the problem was not corrected completely, you will have to repeat the job.

3. ***The electric circuit closes arbitrarily.*** If this is the case, the lamp constantly switches on arbitrarily. The electric circuit closing occurs due to a defective socket where the interior insulated contact touches the body. The socket malfunction is checked with a meter when the socket is disconnected from the contact mechanism. A defective socket should be replaced.

Besides that, the electric circuit closes if the lever *3* turns poorly and does not return to the starting position when the shutter is being wound. It then closes the contact springs.

To eliminate this malfunction, remove the screen *6* (Fig.309) and check whether the lever *3* (Fig.331) turns freely when driven by the spring *8*. Lightly oil the lever shaft - the screw *4*. If the problem cannot be corrected this way, disassemble the camera, remove the spring *8* and strengthen it by slight straightening. Before anything else, check the flash itself.

Exposure Counter

The exposure counter is very simple, and it consists of two parts. The shaft *7* (Fig.312) supports two toothed gears that are not fastened and should be removed at camera disassembly. The gear *12* shaft holds the gear with the counter dial attached to it and pressed by a spring washer.

When the shutter is being wound, the gears *10*, *11*, and *12* rotate, and the dial *13* rotates the toothed couple that turns the gear of the counter with the dial.

Counter malfunctions are very rare. They are usually manifested in free turns of the counter dial. To correct the problem, remove the top chromed shield *6* (Fig.308), remove the gear with the dial, place them both on a hard surface, and strengthen the spring washer by hitting it lightly around the shaft.

In the "Kiev-3" and "Kiev-4" cameras the top chromed shield is not removable. To remove the counter dial, you should remove the top plate.

Film Transport Mechanism

Film transport during the shooting and the release of the exposed film into the cartridge involve the following camera assemblies: the transport sprocket *14* (Fig.312), the reeling fork *6* (Fig.332), and the film rewind mechanism - the shaft *1* (Fig.312) and the fork *4* (Fig.309).

Transport sprocket. Shutter winding occurs simultaneously with the advance of the film to the next fame. The film is pulled by the transport sprocket linked to the shutter mechanism. When the winding knob is being turned, the gear located below it turns along with it and rotates the gear *12* (Fig.312) through the gears *10* and *11*. The long shaft of the gear *12* runs inside the shutter mechanism gears and is connected with the transport sprocket *14* shaft by a pin. The sprocket has a groove for this pin. The sprocket shaft is driven by a spring located inside the sprocket.

When the exposed film is rewound, the only rotating mechanism is the transport sprocket; the gears of the shutter mechanism and film rewind mechanism remain still. To disengage the transport sprocket from the gears of the film transport mechanism, the switch button on the removable back cover must be depressed. The button rod enters the hole *12* (Fig.309), pushes the transport sprocket shaft, lifts it, and puts it out of gear. After that the sprocket can freely turn in either direction. If the switch button is released, the sprocket shaft driven by the spring will return to its place, and the sprocket will set in the working position again.

Mechanism malfunctions. 1. ***When the shutter winds, the film does not advance at all or advances only partly.*** (Sometimes crackling of gears can be heard). Remove the back cover *9* (Fig.307) and take out the film. Next, wind the shutter while holding the transport sprocket teeth with your left hand to imitate the load of film. If the sprocket does not move or if it stops after a few turns and crackling of gear teeth can be heard, the problem should be sought in the rewinding gears.

Having removed the top plate *11* (Fig.308), observe the rotation of the gears *10* and *11* (Fig.312) during the winding of the shutter. The teeth of one or both gears may be damaged which results in lack of smoothness in their movement. The gear *10* is damaged more often. It is almost always possible to correct this problem without replacing the gears. To do that, unscrew the screw *9*, remove and flip the gear *10*.

Sometimes the gear *11* is tilted because its shaft is loose. Check whether the shaft is secured well. A rivet or screw serves as the shaft.

2. ***Poor engagement of the transport sprocket.*** This malfunction has symptoms similar to those of the one described above. The reason for this problem is that the pin turning the transport sprocket shaft becomes displaced, i.e., it is no longer in the sprocket groove.

This happens when the transport sprocket is slightly lowered. Check the tightness of the screw fastening the box *4* (Fig.329). If the screw is tightened but the sprocket is somewhat loose, remove the sleeve and put one or two washers on the sprocket shaft.

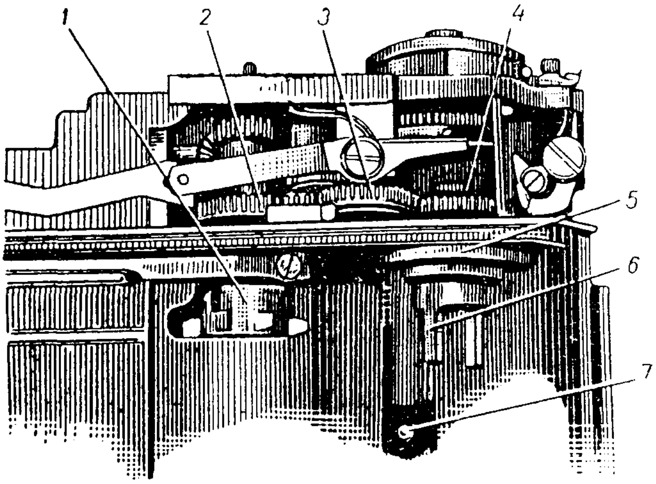


Figure 332. The friction clutch of the reeling fork.

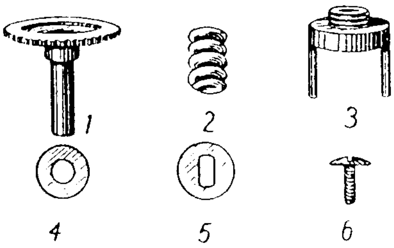


Figure 333. The parts of the film reeling mechanism.

Reeling fork. When the shutter mechanism is wound, the gear *2* (Fig.332) rotates the stopping gear *3* and the gear *4*. The latter turns the reeling fork *6* by friction. The fork rotates the take-up spool which reels the exposed film.

The entire reeling mechanism consists of the gear with the shaft *1* (Fig.333), spiral spring *2*, fork *3*, washer *4*, figured washer *5*, and screw *6*.

The spiral spring *2* is placed on the long shaft of the gear *1* and inserted along with it in the hole of the bushing *5* (Fig.332). The fork *6* is placed on the shaft from the other side of the bushing. The washers *4* and *5* are set into the fork base groove under the screw *6* (Fig.333). The tip of the gear shaft has figured ledges for the washer *5*. Parts of the friction clutch are fastened with the screw *6* that is inserted in the hole in the butt-end of the gear shaft. When the shutter mechanism is removed (see Fig. 346), the gear *7* and fork *8* should rotate in the bushing freely and have little vertical space.

When the gear *4* (Fig.332) rotates during the winding of the shutter, the reeling fork *6* rotates along with it due to the tension of the spring located on the gear shaft. This torque is sufficient for the rotation of the take-up spool. The film is transported by the transport sprocket *1* while the take-up spool just reels the film.

During the rewinding of the exposed film, the gear *4* remains still, and the fork *6* rotates in the opposite direction.

Malfunctioning of the parts of the reeling fork's friction clutch is one of most common malfunctions in the "Kiev" camera.

Mechanism malfunctions. 1. ***The screw 6 is loose (Fig.333).***

Sometimes the M1.4x0.25 screw *6* becomes loose. In that case, the torque of the friction clutch decreases, and the fork does not rotate the take-up spool. It is hard to put back parts of the friction clutch and tighten the screw because this requires overcoming the resistance of a relatively strong spring, as well as putting in place the washer *5* with its figured hole. Besides that, the gear *4* (Fig.332) slightly lowers inside the camera which makes the task even more difficult.

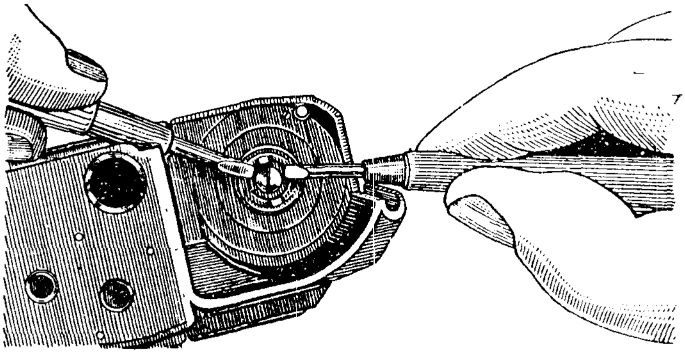


Figure 334. Installation of the film reeling fork.

When a professional puts in the screw, he can feel whether the washer with the figured hole is set in place, but even an expert may have to make several attempts. A lay photographer should keep in mind that the screw must not be tightened with force because the screw head may break off.

If an attempt to assemble the friction clutch fails, disassemble the camera to the state shown in Figure 346, turn the camera as shown in Figure 334, and, having put the gear on a hard flat surface, install the reeling fork. To make the job easier, remove the spring *7* (Fig.332).

To secure the fork, hold two screwdrivers (one in each hand), and push the fork down with them on both sides (see Fig. 334). While holding the fork down with the screwdriver in your left hand, with your right hand put the washer *4* (Fig.333) and washer *5* inside the fork, and screw in the screw *6*. Make sure to set the washer *5* on the shaft ledges. Occasionally, installing the fork takes more than one attempt, and the installation has to be repeated several times. If the vertical space of the friction clutch is too large, it can be decreased using the second washer *4*.

2. ***The head of the screw 6 broke off.*** Remove the broken off piece of the screw from the hole in the gear shaft. To do that, make a slot in it with a sharp tool and unscrew it. If this cannot be done, carefully drill the screw out. As a last resort, disassemble the camera, take out the gear

and saw a 1-1.5 mm deep cut in the butt-end of its shaft. Then insert a screwdriver in the new slot and drive out the screw. The friction clutch assembly is described in Malfunction 1.

3. ***The screw 6 is in place but the spring 2 drive is very weak, and the reeling fork either does not rotate the take-up spool at all or rotates it so that only 15-20 frames of film reel and then the film stops.*** Check whether the side flanges of the take-up spool are deformed. If the spool is in good condition, strengthen the spring *2*. To do that, disassemble the friction clutch, slightly stretch the spring, and put a few washers between the gear and spring. Then reassemble the friction clutch (see Malfunction 1).

Film Rewind Mechanism

If one cartridge and a take-up spool are used, the exposed film has to be rewound into the cartridge.

The film rewind mechanism consists of the knob *5* (Fig.308) with bushing *3*, shaft *1* (Fig.312), fork *4 (Fig.309)*, and spring washer located under knob *5* (Fig.308).

The shaft *1* (Fig.312) has threaded holes on both ends. The fork *4* screw is screwed into the lower end, the screw *4* (Fig.308) - into the upper end.

The assembled film rewind mechanism should have a little space for vertical movement that is taken up by the spring washer. The spring washer makes the movement of the knob smooth and prevents it from rotating arbitrarily.

Mechanism malfunctions. 1. ***The fork 4 (Fig.309) turns with difficulty, and film rewinding is hindered.*** In that case, you should oil the rewinding shaft and check its vertical movement. To increase the space between the shaft and the fork, put the spacer on the fork screw. If the camera has been disassembled, check whether the screws *2* and *3* (Fig.309) fastening the top camera plate are tightened.

2. ***The pins or the screw of the fork broke off.*** Often due to bad cartridges or because the interior spool from one cartridge is put into the other, the rewinding fork breaks. If the fork tips break off, unscrew the fork and replace it with a new one. If the screw breaks, remove the broken part of the fork from the hole in the shaft. (See Malfunction 2 in this section in the preceding chapter.)

Selftimer

The automatic shutter release mechanism serves for automatic shooting 9-15 sec after switching it on. It is located inside the camera (Fig.346); only the winding lever and the release button are outside.

The selftimer mechanism is wound by a lever. This increases the stretch of the very strong tape spring *13* (Fig.346) installed on the selftimer mechanism.

The lever should be pushed all the way during winding or the selftimer will not work. However, it must not be pushed past the thrust pin.

To set off the selftimer, shift the release button in the direction of the arrow etched on it. The button shifts the brake lever that releases the selftimer mechanism pallet, and the mechanism starts working. The lever secured on the spring *13* shaft revolves (the lever is covered by the spring), turns the lever *11* and pin *12* that is located on it. The pin presses the connecting lever *1* (Fig.317b) whose arm pushes down the disk *10* (Fig.319a) and releases the shutter.

Do not wind the camera or change the shutter speeds during the selftimer's operation.

Mechanism malfunctions. 1. ***The selftimer mechanism trips, but the shutter release does not occur.*** This malfunction is caused by deformation of the connecting lever *1* (Fig.317b).

When the screen *6* (Fig.309) is removed, it is possible to observe the selftimer's operation and see that the connecting lever turns insufficiently and does not shift out the shutter release mechanism enough. To eliminate this problem, it is necessary to increase the time of the connecting lever's motion. This does not require camera disassembly. When the screen is removed, the lever *11* (Fig.346) and the cam pin *12* can be seen. Turn the pin slightly with a screwdriver, and in doing this you shall increase the connecting lever's turn.

2. ***The screw 2 head (Fig. 310) broke off.*** The head of the screw (M1.7x0.35) fastening the selftimer lever usually breaks off due to its excessive tightening. The remaining part of the screw can be drilled out with a 1.2-1.4 mm drill bit or cut with a fretsaw (see p.269). During the installation of a new screw, do not forget to put a washer between the lever and the screw *2* head. The washer bends slightly and pushes the lever so it does not move arbitrarily but not so hard that it could hamper the selftimer mechanism's operation.

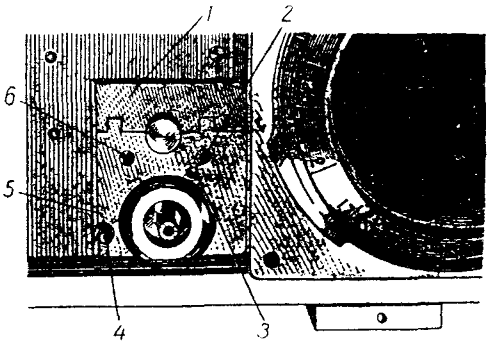


Figure 335. The exterior shields of the selftimer.

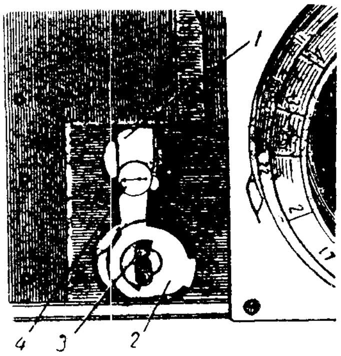


Figure 336. The selftimer's parts.

3. ***The selftimer starts working arbitrarily after the lever is wound.*** Sometimes it starts working before the release button *3* (Fig.310) is pushed. This happens because the pallet has not switched off during the preceding cycle of the selftimer's operation.

The pallet is switched off as follows. The switch *2* (Fig.336) has a lever above the selftimer mechanism. This lever has a hole for the pin *3* located on the central winding shaft of the mechanism. During the selftimer operation, the pin shifts and returns the winding lever to the starting position. At the same time, the pin reaches the end of the lever *2* hole and turns the lever whose arm returns the knob *4* and lever *1* to their starting positions. The lever *1* bending presses and stops the pallet.

If the selftimer starts working by itself, disassemble the protective device on the camera body. Having unscrewed the screw *2* (Fig.310) and removed the washer and lever, carefully peel off the leather (see Fig. 311). Then remove the unfastened shield *1* (Fig.335), unscrew the screws *2*, *4*, and *6*, and remove the shield *5*.

To check the operation of the lever switch *2* (Fig.336), put the winding lever on the mechanism shaft and tighten the screw *2* (Fig.310). The lever *2* (Fig.336) operation is adjusted by slightly bending its tip which pushes the knob *4*.

Sometimes this malfunction can be eliminated by removing the dust that has accumulated on the lever or by adjusting the smooth motion of the release button.

After the leather is glued back during the reassembly (only shellac glue can be used), the release button *4* should move freely.

4. ***The selftimer does not work after the release button 3 (Fig.310) is pushed.*** This problem arises as a result of a dirty selftimer mechanism. Remove the mechanism from the camera and clean it. Before that, try to fix it without removing it from the camera. To do that, partially disassemble the camera and turn the mechanism gears. This often helps, and the mechanism starts to work.

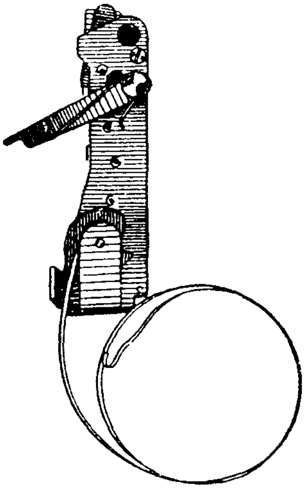


Figure 337. Installation of the selftimer spring.

To take out the selftimer, remove the shields *1* and *5* (Fig.335), unscrew the screws *10* (Fig.346) and *13* (Fig.309). Clean the mechanism in benzine, and lubricate all the shafts as well as the spring with watch oil (not excessively).

Having reinstalled the selftimer in the camera, turn the lever *11* (Fig.346) to the right until it reaches the body wall. This is done when the mechanism is unwound. You can now wind the mechanism. This is the only position in which the shutter can be set so that the connecting lever *1* (Fig.317b) is in front of the pin *12* (Fig.346).

5. ***The selftimer spring is broken.*** In that case, the selftimer mechanism cannot be wound, and the winding lever turns freely. Remove the selftimer from the camera (disassembly and reassembly are both described in detail in Malfunctions 3 and 4), and remove the spring. Do not connect the parts of the broken spring. It can be shortened. One end of the spring is hooked to the head of a pin that is installed in the hole of the winding shaft; the second end is hooked with its figured bending to the bent portion of the selftimer plate. Remove the spring, slightly heat its end in the flame, make a figured bending and put the spring in place. To do that, install the spring's end as shown in Figure 337 and hook it to the pin's head. Rotate the winding shaft until the spring coils around the shaft and its bending hooks to that of the plate.

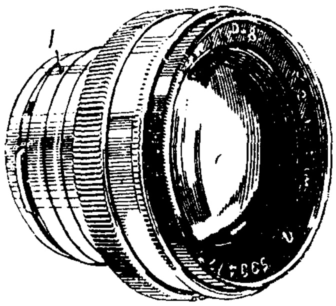


Figure 338. The "Jupiter-8" lens.

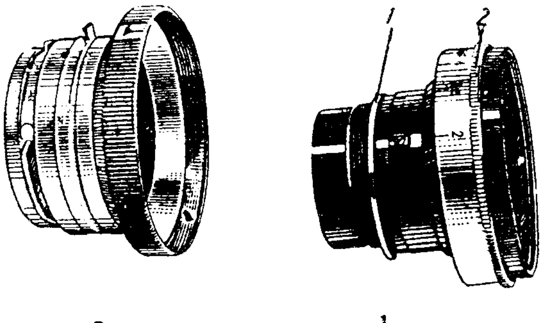
Lens

The "Jupiter-8" lens (Fig.338) installed on the "Kiev" cameras has basically the same design as the "Jupiter-8" lens in the "Zorki" and other cameras (see p.166). The lens blocks are absolutely identical, and the only difference is in the design of the exterior mount. The lenses in the "Kiev" cameras have bayonet mounts.

The lens with a bayonet mount is installed in the camera by placing it in the barrel *4* socket (Fig.310) and turning it at a small angle. Three radial guides on the lens mount enter corresponding grooves of the barrel socket.

The bayonet mount is better than the threaded one because the lens can be installed in the camera quickly and easily.

The lens mount design in the "Kiev" camera and its installation have one very important feature. Lens focusing in the "Kiev" camera, as in every camera, is done by an axial shift which is impossible without a special mount consisting of two or more cylindrical tubes connected through multi-entry threads. In other cameras, this mount usually forms part of the lens. In the "Kiev" camera, the mount with the multi-entry threads is an inseparable part of the body and is coupled with the base rangefinder. It is called the lens barrel (see Fig. 347). In the "Zorki" and FED-type cameras, the lens (the rangefinding part of the lens mount) is coupled with the rangefinder, i.e., the lens controls the rangefinder's operation and the rangefinder cannot work without the lens. Contrary to this, the "Kiev" camera has a rangefinder which works with any main or interchangeable lens or else without the lens. When the lens is screwed into a FED or "Zorki" camera, the butt-end of its mount immediately hits the cam *6* (Fig.256) which may damage the rangefinder adjustment. In the "Kiev" camera, damage to the rangefinder adjustment is unlikely.



a b

Figure 339. The disassembled lens:
a - the exterior mount; b -the mount-block.

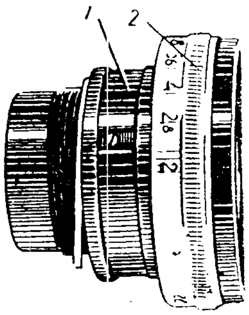


Figure 340. The block of the "Jupiter-8M" lens.

The lens mount of the "Kiev" camera is simple, and the lens is easy to disassemble, but the lens barrel installed on the camera is fairly complex. Its design is discussed separately.

Lens design and disassembly. The lens consists of lens mount ring *a* (Fig.339) and block *b*. To unscrew the block from the lens mount ring, remove the set screw *1* (Fig.338). Block disassembly is described in detail on p.167.

The "Kiev-4A" and "Kiev-4" cameras are equipped with an improved "Jupiter-8M" lens which has a preset diaphragm. The diaphragm's design is simple. The diaphragm tang *2* (Fig.340) is fixed with the aid of the cylindrical roller located under the spring *1*. When the tang turns, the roller gets into a corresponding groove on the block mount.

In addition, the rear component of the "Jupiter-8" lens was placed in the lens mount ring screwed on a thread; in "Jupiter-8M", the rear component is one with the main lens mount ring. To remove the rear component, unscrew the fastening nut in the back of the block mount.

Lens and body adjustment. If the negatives appear blurred when the rangefinder is operating properly, check the lens and body adjustment. To do that, remove the back cover, set the "B" speed, wind the shutter, push the release button and, while holding it down, turn the knob. This leaves the shutter open. Place the ground glass on the screen in the focal plane (with the ground side facing the lens) and set the 4-6-fold magnifying glass in front of it. A device for viewing negatives can be used for this purpose. Then focus the camera on an infinitely distant object (at a distance of no less than 100 m) and, by rotating the lens barrel, find the sharpest image of the object on the ground glass. The barrel scale should set in the ∞ position. Other than that, the scale position indicates lens and body misadjustment. The test should be repeated several times. In the case of misadjustment, check the fastening of lens elements in the lens. Sometimes the rim fastening the front or rear lens element is loose or the rear component mount becomes undone. If the lens elements are secured well, the lens and body adjustment is done using adjusting rings *1* (Fig.339b). By choosing the appropriate ring thickness you can elevate or lower the position of the lens block. If focusing on an infinitely distant object gives the sharpest image on the ground glass when, for example, the barrel range scale stops opposite the number "15", it means that the lens block has to be set lower. Likewise, if the object is at a 5 m distance, and the range scale reading is "7", the block has to be elevated. The block should be shifted slowly, approximately by 0.05-0.10 mm.

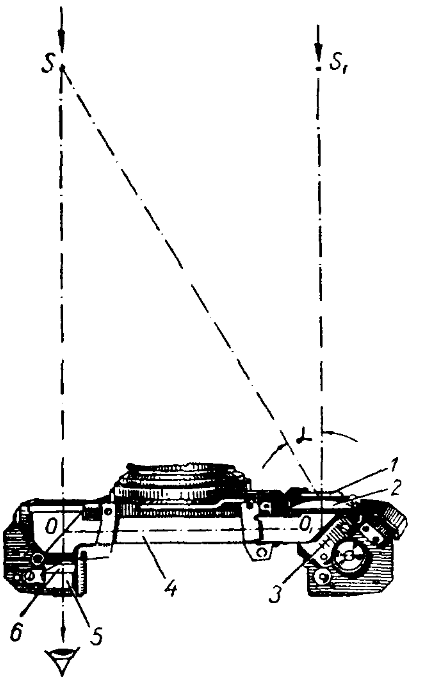


Figure 341. The viewfinder-rangefinder diagram.

When the lens and body adjustment is completed, set the diaphragm tang *2* correctly because the diaphragm scale may become displaced during the adjustment. To do that, unscrew three set screws, shift the tang to match the figure "2" with the indicator when the diaphragm is fully open, and tighten the set screws.

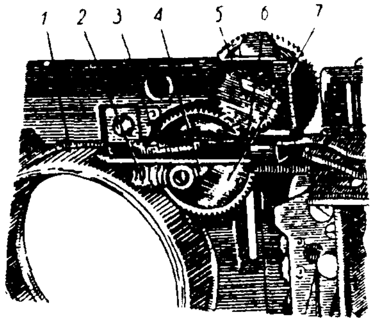
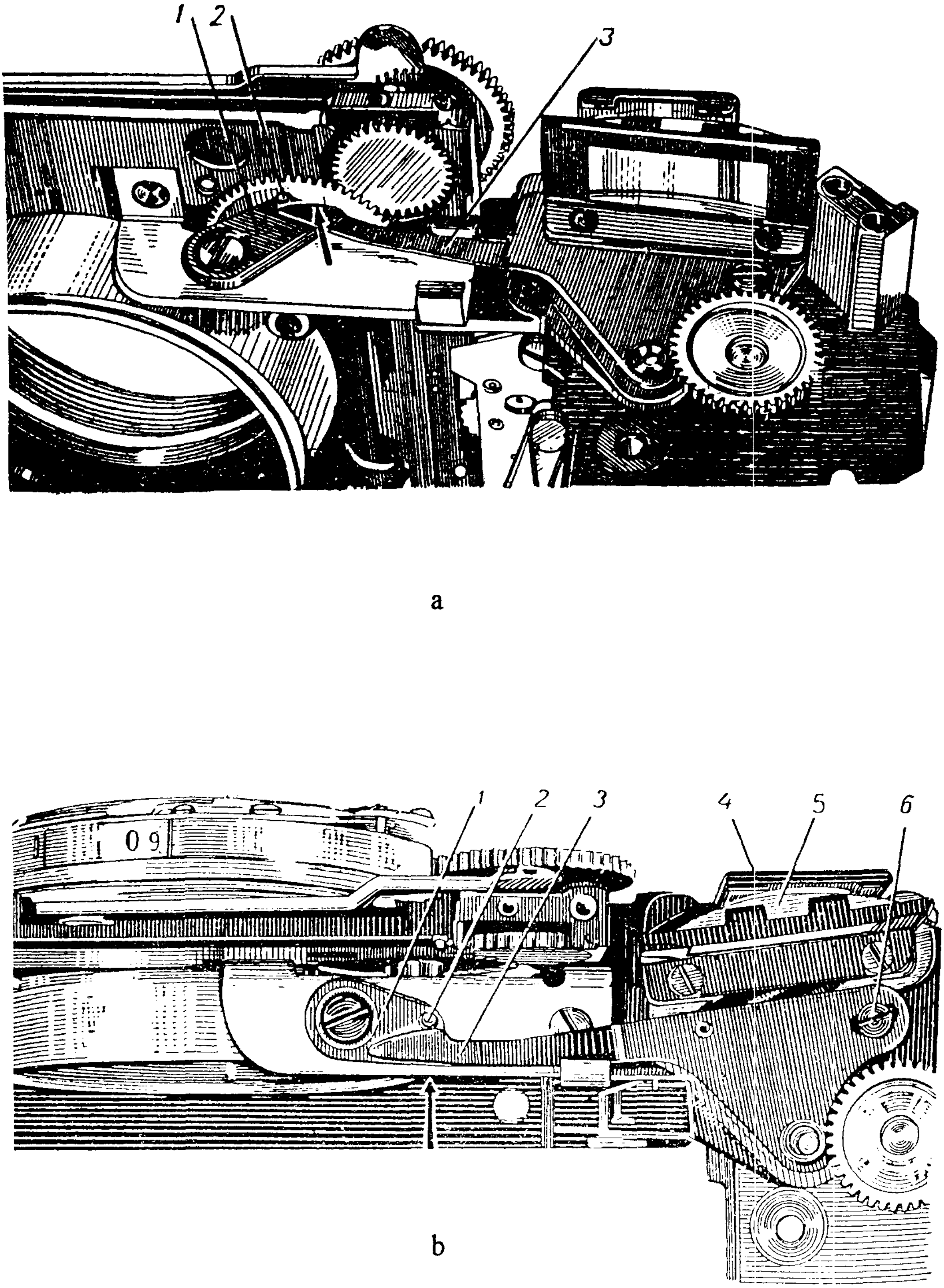


Figure 342. The system of the driving gears.

Viewfinder-Rangefinder

The "Kiev-2" camera is equipped with a base rangefinder joined in a single field of view with the viewfinder. The rangefinder base is 90 mm. The large rangefinder base affords better precision at focusing. The "Kiev-2" camera rangefinder malfunctions less frequently than other rangefinder systems due to an integrated design of the cemented lens elements.



a

b

Figure 343. The position of the compensator parts:
a - at the setting to ∞; b - at the setting to 0.9 m.

Design and operational principle. The viewfinder-rangefinder consists of the block of cemented prisms *4* (Fig.341) with a semi-transparent beam-splitting layer on their joint at 45° to the eye; the optical wedge compensator (see p.25) consisting of the fixed plano-concave lens element *1*, the rotating segment-shaped element (plano-convex lens element) *2* secured on the moving base *3*; the two-lens element telescopic rangefinder, i.e., the negative dioptre front lens *6* and positive dioptre rear lens *5*. The rangefinder operation is closely connected with that of the lens barrel *4* (Fig.310) and consists in focusing the lens on the object by correctly setting the barrel.

Turning the rangefinder wheel *4* (Fig.311) activates a system of gears that rotates the moving part of the barrel *1*. The wheel *4* is set and secured with a screw on the shaft of the gear *5* (Fig.342). The gear *5* rotates the gear *7* that activates the moving part of the barrel *1*. This is how the lens axial shift is achieved. Simultaneously, the worm *4* of the gear *7* rotates the gear *2* along with the lever *3* fixed on it. The lever *3* pin turns the compensator lever *6* against which it rests. This is how the plano-convex lens of the compensator is shifted.

Consider an object at point S (Fig.341). Two images are visible at focusing by the rangefinder: the directly viewed still image marked with the straight dotted line from the point S to the eye, and the moving orange-colored image formed after several reflections of the object from the compensator and the two planes of the glued prism block. If the camera is focused on an infinitely distant object, the lines SO and $S_1 O_1$ are practically parallel, and both images (still and moving) must coincide when the lens barrel is set in the ∞ position. This is the principle of rangefinder adjustment.

To make both images coincide when the object is close, turn the plano-convex lens *2* that changes the parallax angle α. The closer the object, the more the lens *2* should be turned.

Rangefinder adjustment. In the "Kiev" cameras, vertical and horizontal rangefinder adjustment is done somewhat differently than in other cameras discussed so far; though the principle of adjustment is the same. The "Kiev" camera rangefinder adjustment is difficult because it requires complicated camera disassembly.

Vertical and horizontal adjustment is done with the compensator alone. Therefore, its design should be discussed in detail. Figure 343a,b shows the positions of compensator parts when the rangefinder is set to the ∞ and 0.9 m positions. When the lens barrel shifts toward 0.9, the lever *1* (Fig.343a) turns the compensator lever *3*. The lever *3* is returned in the opposite direction by the spiral spring located under it. Thus, the curved surface of the lever *3* (see arrow

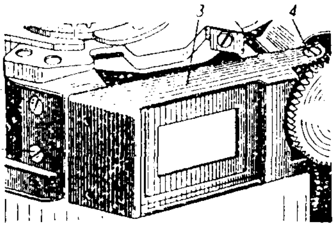


Figure 344. The compensator shield.

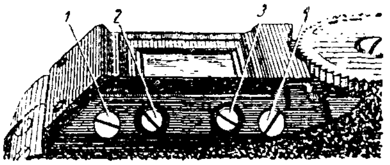


Figure 345. The compensator fastening and adjusting screws.

in Fig. 343a) always touches the pin *2*. The lens elements *4* and *5* (Fig.343b) are secured by the bendings in the metal mounts and cemented.

To check the accuracy of the rangefinder's adjustment, focus the camera on an infinitely distant object and on an object positioned 1 m away. The lens barrel should set accordingly in the ∞ and 1 m positions. If this does not happen, the rangefinder works incorrectly. This is how the horizontal adjustment is checked.

The vertical adjustment is checked by focusing on an object located at any distance. The moving image should move on the same level as the still image. If the moving image is above or below the still image, vertical adjustment is off.

The vertical adjustment is corrected first. A slight deviation in vertical adjustment can be disregarded because it does not affect the image sharpness significantly.

To correct the vertical adjustment, take off the top plate, the screen, the front shield, and remove the shutter from the body (see p.247). The camera with all these parts removed is shown in Figure 346. Then remove the shield of the compensator *3* (Fig.344) fastened with the screws *1*, *2*, and *4*. The diameter of the screw *4* may vary.

Do not confuse vertical misadjustment and tilted images. Sometimes the moving image (some vertical line) is not parallel to the still image but tilted. This phenomenon may be observed during vertical adjustment. The vertical adjustment is corrected using the compensator front lens element *4* (Fig.343b); to straighten tilted images - use the lens element *5*.

The lens element *4* has to be slightly elevated or lowered. To do that, dissolve the glue holding its edges in pure acetone. New glue has to be made for regluing the lens. Wash the emulsion layer off the photographic film with water and dissolve this film in acetone to make a thick paste. Apply a little paste on the edges of the lens element and adjust the lens position while the glue is not set. A frame with the front lens element may be removed for this job. To do that, gently unscrew the screws *2* and *3* (Fig.345) to avoid damaging the thread in the soft metal. These screws cannot be substituted. If a longer screw is put in, the lens element *5* (Fig.343b) will not turn. The frame with the front lens element should be pulled forward only.

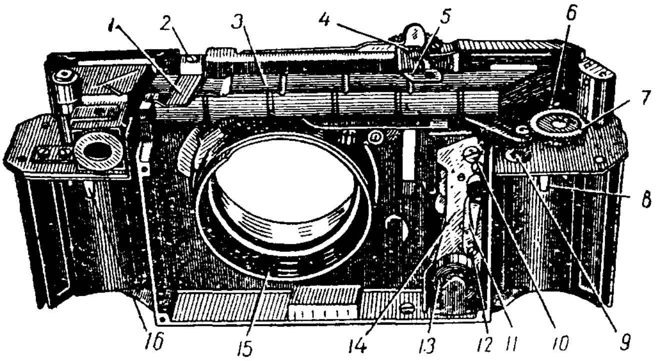


Figure 346. The camera body.

The distance between lens elements *4* and *5* should not exceed the thickness of rice-paper.

If it is necessary to remove the block of cemented prisms *3* (Fig.346), unscrew the screws *2* and *4*, and remove the spring holders *1* and *5*. Clean the surfaces that are not covered with flat paint.

Similar camera disassembly is done for the horizontal adjustment, but this time it does not require the removal of the shield *3* (Fig.344) and the prism. The horizontal adjustment is accomplished by shifting the compensator lever *3* (Fig.343a) or the entire compensator. The goal is to find a position when focusing on an infinitely distant object and on an object located 1 m away gives correspondingly ∞ and 1 m readings on the barrel range scale.

Let us say, focusing on ∞ gives a 20 m reading on the barrel range scale. Set the barrel in the ∞ position, untighten the screw *6* (Fig.343b) by one turn and slightly shift the lever *3* (Fig.343a) to overlap both images of an infinitely distant object. Then tighten the screw *6* (Fig.346) and check the barrel scale reading at focusing on 1 m. If the mark on the scale does not match the 1 m index, continue the adjustment by shifting the entire compensator. To do that, untighten the screws *1* and *4* (Fig.345) by half a turn and slightly shift the whole compensator to the right or left. Having achieved the correct reading at a 1 m distance, check the reading by focusing on ∞ once again. This should be repeated several times until the ∞ and 1 m readings are correct.

If during the horizontal adjustment it appears that the vertical adjustment is slightly off, shift the compensator a little forward or backward. To do that, insert a screwdriver between the body and screw *1* or screw *4*, and shift the compensator. Several attempts are bound to produce the necessary result.

Doing the horizontal adjustment by the same method is complicated and requires certain skills.

The horizontal adjustment can also be made by shifting the lens barrel. This is a much easier procedure. Rangefinder adjustment with the aid of the barrel is described in detail in Malfunction 3 on p.281.

However, this is not always possible. The surface of the lever *3* (Fig.343a) is curved in a way that makes the reading on the barrel scale dependent on the position of the pin *2* sliding along the lever's surface.

The correct positions of the pin at ∞ and 0.9 m are shown in Figure 343a,b. When the barrel is set in the ∞ position (Fig.343a), the pin should be located by the left edge of the lever curve; when the barrel is in the 0.9 m position, the pin has to be by the right edge of the curve. The distance between the edge of the lever *1* and the edge of the plate bearing it should be approximately 1 mm (see arrow in Fig. 343b).

If the rangefinder is adjusted by shifting the barrel, it may displace the lever *1* (Fig.343a) and break its coupling with the compensator lever *3*. Therefore, only small adjustment corrections can be done using the barrel. It can be shifted no farther than by one or two teeth.

When undertaking rangefinder repair, check the mobility of the lever *3*. Make sure that the spring returns it to the starting position and that it is not restrained by the lever *1*. To check that, push the lens element *5* frame (Fig.343b) with your finger from the right side and watch it return to its starting position.

Malfunctions and their elimination. In addition to the main malfunction associated with the vertical and horizontal adjustment of the rangefinder, other problems are possible.

1. ***The moving image in the rangefinder does not shift within the 0.9 m - ∞ range.*** Sometimes the lens barrel rotates within the 0.9 m - ∞ range but the moving image only shifts up to a certain point and stops. The second moving image is observed at the turn of the lens element *5* (Fig.343b) fastened on the lever *3*. Thus the reason for the malfunction should be in the lever's operation. Sometimes a screw that fell out of the mechanism or some other foreign object gets under the lever, and the compensator stops functioning. You will then have to disassemble the camera and examine the compensator.

This malfunction may also arise when the short screws *5* and *6* (Fig.310) are replaced with long ones.

The immobility of the compensator lever may be caused by an impact or shock to the camera.

2. ***The rangefinder wheel 4 (Fig.311) is not secured.*** Rangefinder focusing is done by the rotation of the wheel that turns the compensator lever through a system of gears.

The wheel is installed on the shaft of the gear *5* (Fig.342) and fastened with a screw. Sometimes the screw becomes loose, the wheel falls off, and it stops turning the gear shaft. In that case, the wheel rotates freely, and the image in the rangefinder remains motionless. Remove the front shield *7* (Fig.310), put the wheel in place, and tighten the screw. Install the wheel gently because the shaft bearing it may lower inside the camera.

3. ***Poor visibility of the image.*** Poor visibility in the rangefinder arises as a result of the soiling of optical elements, front protective glass in particular: square or rectangular. Do not touch the front protective glass with your fingers. To clean the glass, breath on its surface and wipe it with a piece of hygroscopic cotton. If the inside surface of the glass is dirty, remove the front shield *7* (Fig.310) and clean it. The smaller square glass is not secured, but the rectangular glass is mounted and can be slid up. Having removed the protective glass, clean one surface of the prism and the compensator. This should be done with the utmost care because the lens element is glued and may be damaged. At reassembly, do not forget to set the metal bushings in front of the protective glass. The bushings are slightly bent so that the glass and frame are pressed by the front shield.

If the protective glass was broken, it is necessary to install good quality plano-parallel glass or else the rangefinder will not work properly.

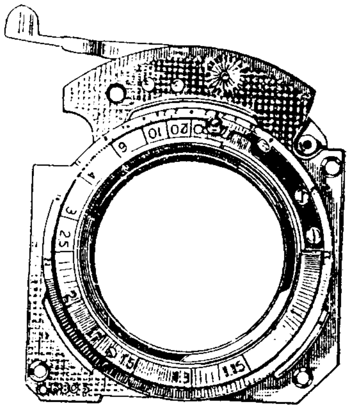


Figure 347. The lens barrel.

Lens Barrel

The lens barrel *4* (Fig. 310) serves for setting the lens and its axial shift as well as for coupling with the rangefinder (see p.273). It is an intermediate link between the lens and the rangefinder. The Figure 347 shows a barrel that has been removed from the camera.

Design and disassembly. The barrel consists of the plate and two cylindrical tubes connected by a multi-entry thread (see Fig. 348). The plate bears a lever for fixing the barrel in the ∞ position. The barrel is fastened with the screws *5*, *6*, *8*, and *9* (Fig.311). The screw *5* is shorter than the other screws.

Considering the complexity of the rangefinder's design and the precision required in the installation of the lever *1* (Fig.343), remove and install the barrel very carefully to avoid displacing the lever. Remove the barrel when it is in the ∞ position. This is not applicable in cases when the barrel is jammed and cannot be turned. At such times you must hold the wheel in your right hand as shown in Figure 349, while pressing down the lever that supports the barrel. Install the barrel the same way when the rangefinder and the barrel itself are set in the ∞ position.

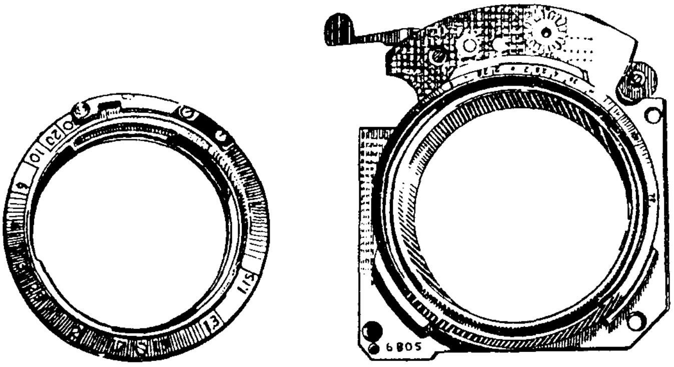


Figure 348. The barrel parts.

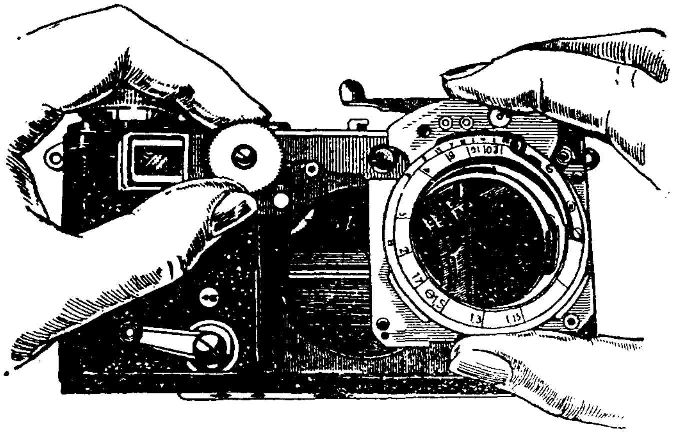


Figure 349. Installation of the barrel on the camera.

There are washers between the barrel and body under the screws *5*, *6*, *8*, and *9* (Fig.311) which are used for adjusting the camera working distance.

Malfunctions and their elimination. If the camera is used properly, the barrel rarely needs repair and removal from the camera. However, sometimes it is necessary to remove the barrel. Here are some of the reasons.

1. ***The barrel becomes deformed.*** When the camera is dropped or hit, the barrel becomes deformed (its middle bends inside the camera). The moving part of the barrel either completely

stops turning or does not shift within the 0.9 m - ∞ range. If the deformation is small, the barrel continues to rotate but does so with considerable difficulty.

To eliminate this problem, remove the front shield *7* (Fig.310) and the barrel. Then straighten the barrel's plate. If straightening the plate does not help, put some grinding powder or paste on the multi-entry thread and grind it in by rotating the moving part of the barrel back and forth for a while. Then wash the barrel parts in benzine, lubricate the multi-entry thread, and reassemble the barrel. It is very easy to connect the multi-entry threads (the thread is left-handed).

2. ***A dirty multi-entry thread.*** Symptoms and elimination of this malfunction are similar to those described in Malfunction 1. In this case, the moving part has to be cleaned in benzine and lubricated.

3. ***Horizontal rangefinder misadjustment.*** As it was pointed out in the description of the rangefinder's design and repair, sometimes horizontal rangefinder misadjustment may be corrected using the barrel.

This applies to cases when the deviation in adjustment is minor and can be corrected by shifting the gear *7* (Fig.342) no more than by one or two teeth. If the gear is shifted farther than that, the lever *3* may shift so that its pin separates from the lever *6*. To correct the problem, set the barrel in the ∞ position; remove the screws *5*, *6*, and *8* (Fig.311) and untighten the screw *9*; holding the wheel (see Fig. 349) in your fingers, lift the barrel, and separate it from the gear *1*. Then focus the camera on an infinitely distant object, overlap the moving and still images by rotating the wheel *4* (Fig.311), and put the barrel back in place.

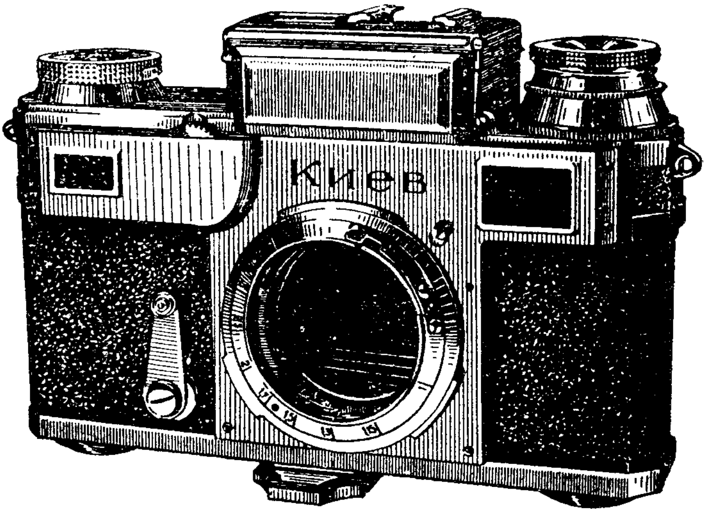


Figure 350. The "Kiev-3" camera.

Latch spring (lens lock). There is a latch spring *8* (Fig.310) on the barrel for mounting the lens onto the camera. It is a spring lath with a groove, and it is fastened to the barrel with two short M1.4x0.25 screws. If a long screw is inserted, the barrel's moving part will either completely stop turning or will not be able to reach the ∞ index. As these screws tend to become loose and get lost, they should be tightened periodically.

Often lay photographers cut a thread for screws of a larger diameter when the M1.4x0.25 screws are not available. This should be done very carefully because the end of the tap may damage the multi-entry thread of the worm inside the barrel which would be difficult to correct. Thus, if a new thread has to be cut, the tap should be screwed in by a few threads only.

"KIEV-3"

The "Kiev-3" camera (Fig.350) differs from the "Kiev-2" camera because of the addition of the photoelectric exposure meter.

The exposure meter installed on the top plate slightly changes the camera's disassembly order. To remove the top plate, disassemble the camera the same way as you would the "Kiev-2" camera (Fig.349), but in order to make the disassembly easier, remove the rewinding shaft along with the film rewind mechanism knob. To do that, unscrew the fork while holding the rewind knob, remove the knob along with the shaft, and be sure to save the fork screw washers. Also, the exposure counter in the "Kiev-2" camera should be removed before the plate, while the counter dial in the "Kiev-3" camera is removed along with the plate. Thus, remove the plate carefully. A thin steel wire may be placed under the counter to make removal of the counter dial from the shaft easier. When installing the top plate on the camera, hold the camera horizontally in your left hand and, having put the counter dial in its place on the plate, put on the plate with your right hand.

Exposure Meter

An exposure meter (Fig.351) serves for indicating the necessary exposure time. It consists of the photo element located behind a transparent ribbed plate and protected with a hinged cover, an electric meter - galvanometer with a scale, and a calculator. The exposure meter indicates the speed value by the average luminance of the object in the range from 25 to 50, 000 apostilb.

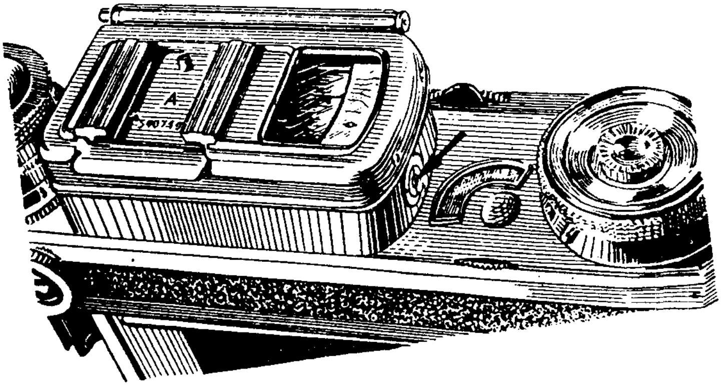


Figure 351. The photoelectric exposure meter.

The exposure meter function consists of the following. When the cover is open, light beams penetrate the ribbed plate and hit the photo element that generates the electric current. The current runs through the galvanometer and moves the needle; the movement of the needle depends on the luminance of the object. The current in the galvanometer is controlled by a variable resistor set in the electric circuit parallel to the meter. The calculator registers the result of the exposure meter's work.

Maintenance, damages, and repair. The exposure meter requires gentle handling. It may be damaged by shocks, impact, and moisture. If raindrops or snowflakes penetrate the photo element, it may stop functioning shortly afterwards, and the electric contacts may become oxidized. The exposure meter should not be left uncovered, particularly if exposed to direct sunlight.

Most malfunctions of the exposure meter associated with damage to the photo element, galvanometer, and variable resistor can be eliminated only at a manufacturing plant. They include the following. 1. ***The galvanometer's needle does not move and is not in the zero position when the front shield of the exposure meter is being opened.***

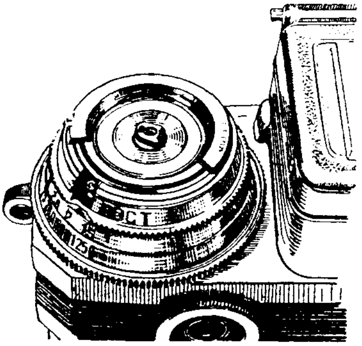


Figure 352. The exposure meter calculator in the "Kiev-3" camera.

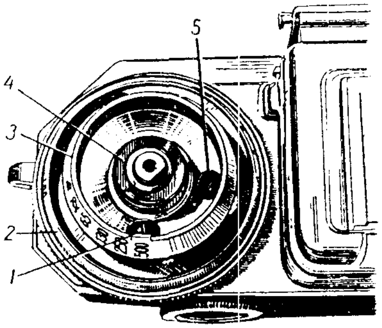


Figure 353. The calculator parts in the "Kiev-3" camera.

2. ***During the shifting of the calculator tang, the needle of the galvanometer moves not smoothly but jerkily.*** This is caused by a bad resistor.

3. ***The galvanometer's needle does not move but shifts arbitrarily when the camera is tilted.*** It is a result of damage to the coil winding of the galvanometer or of a bad photo element.

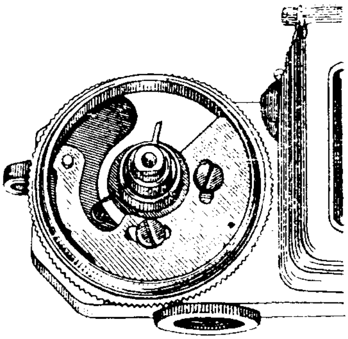


Figure 354. The ring with the contact spring.

A lay photographer can correct the following malfunctions of the exposure meter.

1. ***Wrong readings of the exposure meter.*** The problem can easily be corrected with the aid of special instruments frequently unavailable to a non-professional. This job can also be done without the instruments because it has been empirically concluded that small deviations between the meter reading and the necessary shutter speed do not have any significance. Knowing the deviation value the photographer can make the necessary corrections. Besides that, most exposure meters acquire minor reading errors from time to time which can be corrected by the photographer when the shutter speed is being set.

The exposure meter is adjusted by shifting the scales of the galvanometer and calculator. To shift the galvanometer's scale, insert a screwdriver in the screw slot (see arrow in Fig. 351) and slightly turn it. If the screw does not turn, you should somewhat loosen the nut that is fixing it, and tighten it after the adjustment is completed. The galvanometer's scale should be shifted by small amounts.

If the exposure meter readings deviate from the real value by over 50 percent, the meter should be adjusted with the aid of the calculator (Fig.352). Suppose the calculator's estimated speed is 1/125 sec instead of 1/250 sec, i.e., half the needed speed. In that case, change the position of the calculator dial by turning the top still dial *3* (Fig.353) counter-clockwise by approximately 3 mm or by shifting the contact spring fastened on the lower moving dial *2* in the same direction. To shift the dial *3*, loosen the nut *4* by 1/4 of a turn, shift the dial, and retighten the nut. To shift the contact spring, turn the dial *2* to match the two holes on the dial *3* and the heads of the screws *1* and *5* fastening the contact spring; loosen the screws a little and shift the spring. Figure 354 shows the spring with longitudinal grooves under the heads of the screws used for shifting the spring. Do not touch the variable resistor that is slid along by the spring's contact.

In some "Kiev-3" cameras, the dial *3* (Fig.353) is screwed on a thread and fastened with a set screw instead of a nut. In that case, adjustment is done with the contact spring. If this is not enough, unscrew the set screw, shift the dial, and, having completed the exposure meter's precise adjustment, drill a new hole and cut a thread for the screw.

2. ***There is no contact in the electric circuit.*** In that case, check the contact between the photo element and the spring plate located under it. To do that, unscrew the side screws and remove the top protective shield, remove the protective glass, unscrew two screws, and take out the holder of the front transparent ribbed plate as well as the ribbed plate itself. When removing the photo element, hold it by the edges and be careful with the wires.

The surface of the spring plate and the bottom side of the photo element may become oxidized and cause bad contact. To correct this problem, clean the bottom side of the photo element and spring plate, and check the soldered wire joint.

When reassembling the exposure meter, make sure that the joint of the wire and photo element does not touch the camera body.

3. ***The top protective glass has broken.*** To eliminate this problem, unscrew the four side screws fastening the top shield to the plate. If a new protective glass cannot be cut out, it can be replaced with a plastic plate. To fix it in place and prevent clinking, glue the glass plate to the edges with shellac.

"KIEV-4"

The "Kiev-4" camera (Fig.355) differs from the preceding models by the addition of a miniature highly sensitive exposure meter and a modernized "Jupiter-8M" lens (see p. 273). Besides that, the removable back cover is sturdier and has better locks. The tripod socket *1* (Fig.356) is installed on the camera body. The film rewind mechanism is slightly changed. The top plate is removed in the same way as in the "Kiev-3" camera. However, to take out the knob and shaft of the film rewind mechanism, unscrew the screw *2* while holding the rewinding knob and remove the fork *3*. There is a washer and a spiral spring under the screw.

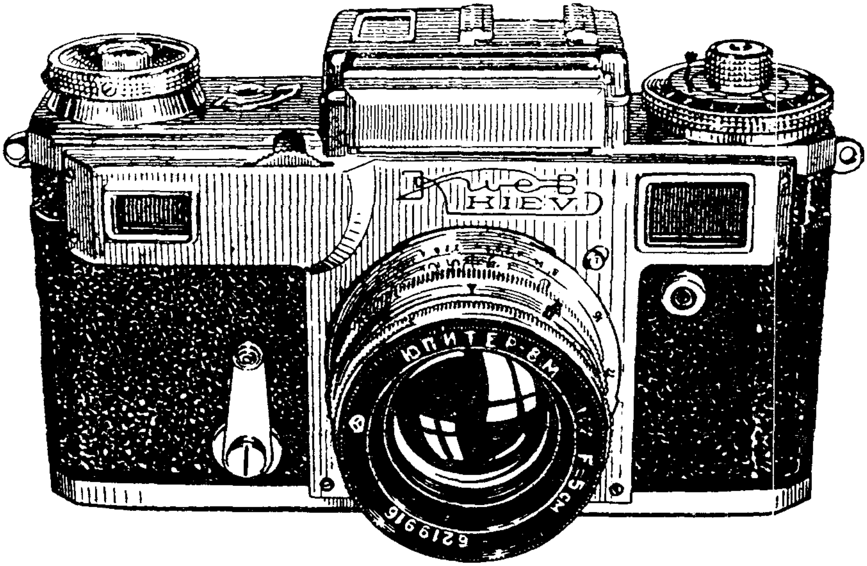


Figure 355. The "Kiev-4" camera.

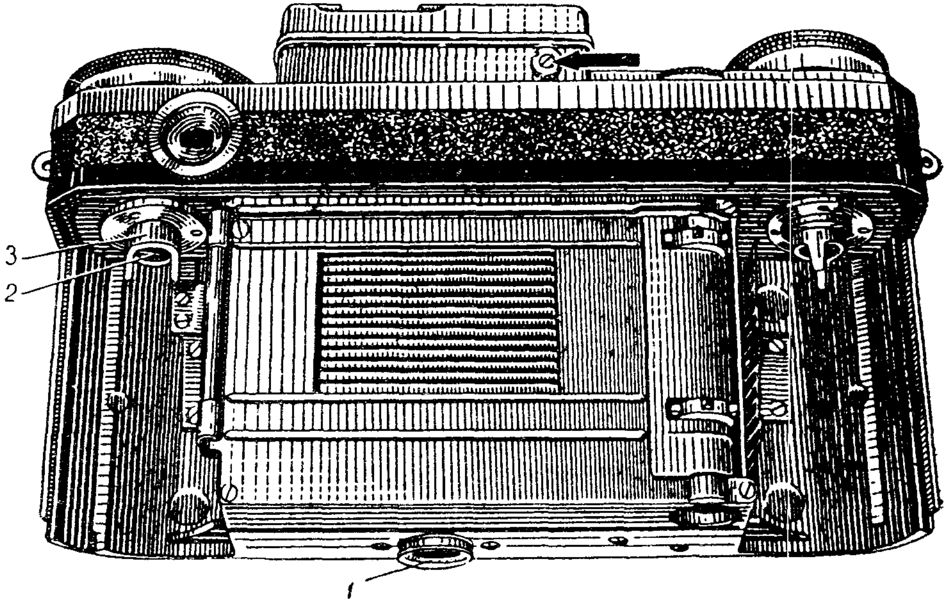


Figure 356. Camera without a removable cover.

The sensitivity of the exposure meter in the "Kiev-4" camera is increased, the meter works in a luminance range from 25 to 100, 000 apostilb. Its design and repair are described on p.282. The exposure meter adjustment is similar to that in the "Kiev-3" camera, but the location of some galvanometer and calculator parts is slightly different which affects their adjustment. The galvanometer scale adjustment screw is located in the back part (see Fig. 356). The top dial of the calculator is not shifted; instead, adjustment is done by shifting the contact spring. To do that, unscrew the screw *2* and remove the fork *3*; remove the knob *2* (Fig.357) with the shaft; unscrew the screws *1*, *3*, and *4* and remove the dial *5*. There is a spring washer under the dial. Next, remove the dial *1* (Fig.358) with the contact spring secured to its bottom. Be careful with the bushing *2* because it is not secured and may fall out. At reassembly, it has to be installed so that the tips fit into the slots of the fastening nut *3*. Usually the exposure meter can be adjusted by shifting the galvanometer scale.

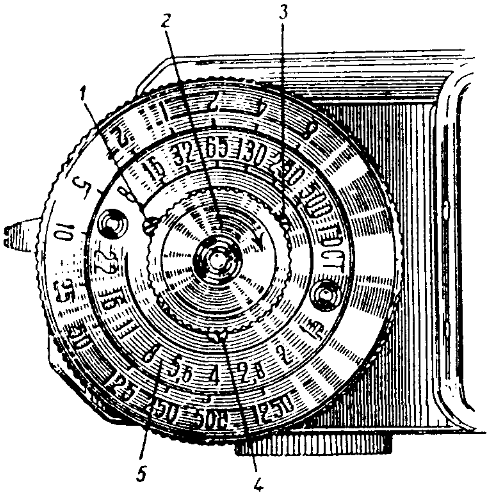


Figure 357. The exposure meter calculator in the "Kiev-4" camera.

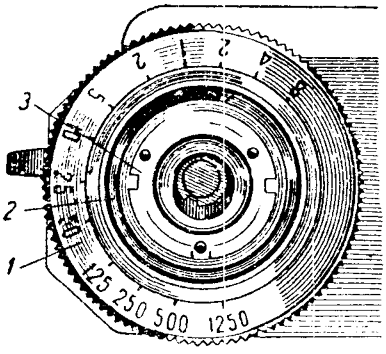


Figure 358. The calculator parts in the "Kiev-4" camera.

"START"

The "Start" camera (Fig.359) is a contemporary single lens reflex camera of high class. Its advantages are the following: a large shutter speed range (from 1 to 1/1000 sec and the "B" and "T" speeds); the option of using two cartridges and a knife for cutting the film inside the camera that allows you to remove part of the exposed film in the light; the visible image in the viewfinder's field of view is 22x33 mm (at 24x36 mm frame size) which is much larger than in the "Zenit" camera (20x28 mm); a shutting range from 0.7 m to ∞; a lever shutter winding; a lens with a semi-automatic pressure diaphragm; special focusing optical wedges for focusing not just by means of the ground glass but in the same way as in cameras equipped with rangefinders; the option of using the "Zenit" camera's interchangeable lenses; a bayonet lens mount for easier and faster installation; interlocked operation of the shutter, exposure counter, and film rewind mechanism.

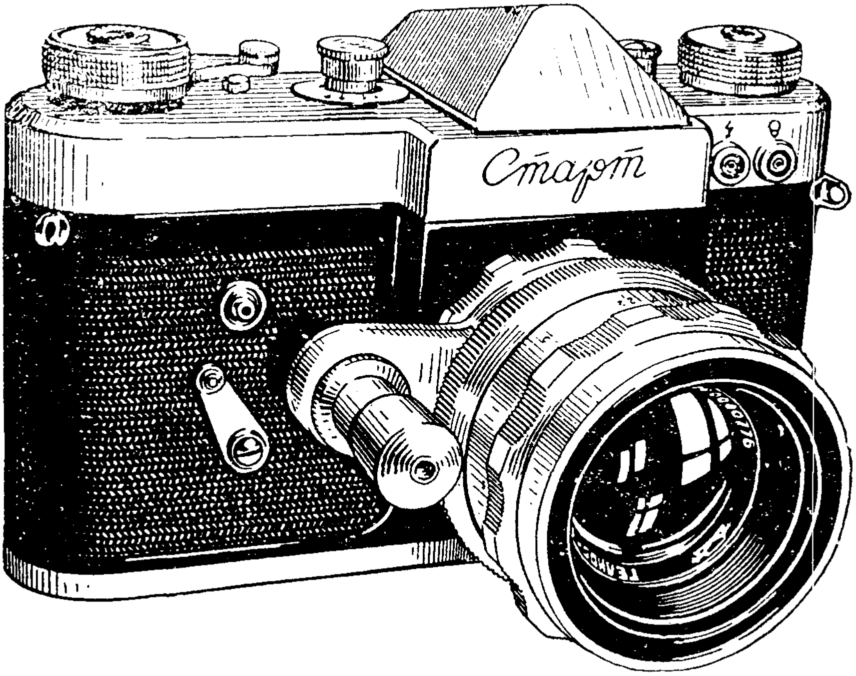


Figure 359. The "Start" camera.

Camera Disassembly and Reassembly

Most repair is done with partial camera disassembly which includes the removal of the top shield *14* (Fig.360) and the screen *11* (Fig.367).

Camera disassembly begins with removal of the winding lever *13* (Fig.360). There are several types of winding levers. Most defects in the "Start" camera are caused by winding device malfunctions (the lever in particular). The disassembly and reassembly of three kinds of winding mechanisms and levers is described below, followed by a description of their design and repair.

The "Start" cameras with the winding lever of the first type are easy to identify by protective pieces of glass (plastic) installed on top of the film rewind mechanism knob and above the exposure counter dial.

Figure 361 shows a winding lever of this model. To disassemble the winding mechanism, unscrew the set screw *3* and bushing *1* and unscrew the ring *2* from the friction clutch bushing (the bushing is black). To do that, insert a screwdriver in the slot on the bushing and unscrew the ring while holding the bushing to prevent it from rotating. Cover the exposure counter dial with a piece of rubber, press it with your thumb, and unscrew the dial. To remove the friction clutch, unscrew the nut located in its center. Further disassembly is the same as in the winding mechanism of the second type described below.

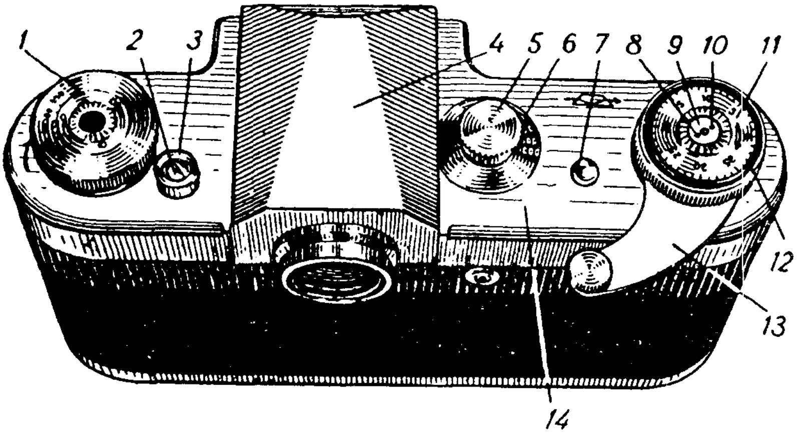


Figure 360. The camera exterior parts.

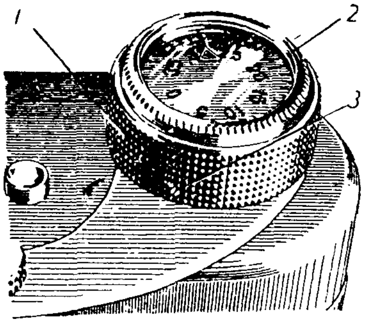


Figure 361. The winding lever's exterior parts in earlier models.

The second type of winding mechanism is shown in the Figure 360. Most "Start" cameras manufactured before the mid sixties are equipped with a lever of this type. To disassemble it, remove the round black patch covering the nut *9*, unscrew the screws *8* and *10*, and unscrew the nut *9* by inserting tweezers or a key in the holes for the screws. Remove the exposure counter dial *11* and the black spring washer located under it. The spring washer is located on the disk set on the shaft *3* (Fig.362). A washer may be installed on the shaft in addition to the disk. Remove the disk and washer after memorizing their positions. Then unscrew the nut *1* and remove the disk *2*. Unscrew the nut *2* (Fig.363) and remove the lever *1* installed on the winding clutch *2* (Fig.365). The winding clutch is set on the shaft of the winding mechanism and is easily removed. Note the cut-out on the clutch *2* (Fig.365). The pin *2* (Fig.364), located on the bottom of the winding lever, enters this cut-out. It is much larger than the lever pin. The purpose of this is to make it possible to set the lever in the idle position after the shooting. When removing the clutch, memorize the position of its cut-out.

Later versions of the "Start" camera are manufactured with a winding lever of another type. Figure 366 shows such a lever along with its fastening on the winding bushing. There is no winding clutch *2* (Fig.365). The lever (Fig.366) is installed directly on the winding bushing *9* (Fig.372) and is fastened with the nut *1* (Fig.366). The nut has a *left hand thread*.

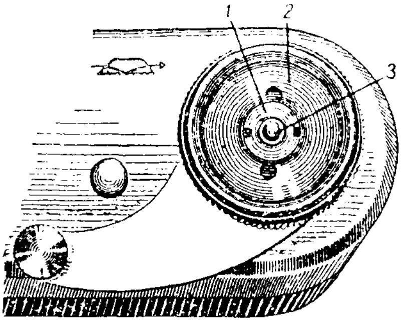


Figure 362. The exterior parts of the winding lever.

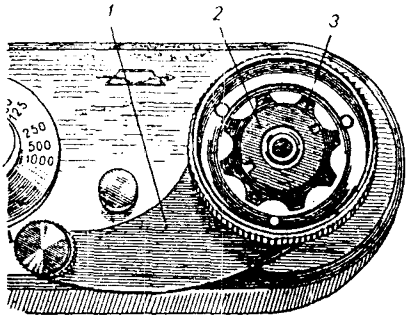


Figure 363. The interior parts of the winding lever.

Having removed the winding lever, unscrew the screws *1* and *3* (the screw *1* is somewhat shorter). If these screws are switched during the reassembly, the winding mechanism will not function. You should next remove the pentaprism *4* (Fig.360), unscrew the two set screws and remove the shutter speed mechanism knob *5*; unscrew the film rewind mechanism knob *1* while holding the rewinding fork *6* (Fig.367) with pliers; unscrew the nut *2* (Fig.360) along with the screws *1* and *2* (Fig.367); lift the top plate *14* (Fig.360) to remove the end of the guiding tube from the opening in the screen. The guiding tube holds the knife rod inside. Pull out the knife by sliding it down and remove the clutches with the flash synchronization wires soldered to them from the socket rods. Memorize the positions of the wires (they have different color). Having removed the shield, you should also remove the switch button *7* (Fig.360) and the spiral spring located under it so they do not fall out.

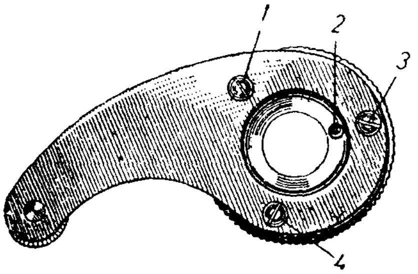


Figure 364. The winding lever.

Reassembly is done in the reverse order. Before installing the top shield, put the spring on the shaft *13* (Fig.372) and secure the button *7* (Fig.360) in the shield openings. To do that, slightly lubricate the button with thick grease.

When installing the winding lever *13*, tighten the nut *2* (Fig.363) well. Tighten the nut *1* (Fig.362) gently to avoid damaging the thread.

To remove the screen *11* (Fig.367), unscrew the screws *3*, *5*, *8*, *9*, and *10*. Usually the top shield is removed first and then the screen because it is easier to remove the latter after the tube with the knife *4* have been removed. If camera repair only requires removal of the screen, it is taken off without removing the top shield. To do that, insert a screwdriver blade through the opening (see arrow in Fig.388) and loosen the set screw by 1-1.5 turns. The screw is well visible and is used to fasten the knife tube. After loosening the screw, pull up the tube with the knife by the clutch *3* (Fig.360).

Complete disassembly. Further camera disassembly is required for complicated repairs of the shutter, selftimer, mirror drive mechanism, flash synchronization mechanism, and in some other cases. To take out of the body the top assembly panel where all major camera parts and devices are assembled, unscrew the screw *1* (Fig.385) and remove the handle *2* with the adapter. Next, unscrew the bushing *3* with the release button. There may be washers located under the bushing which control the height of the bushing's setting. They should be removed and reinstalled at reassembly. It is not recommended to disassemble the release button assembly. Unscrew the screws *1*, *2*, and *3* (Fig.368) and slightly pull the mechanism out of the camera (see Fig. 369) to open the contacts and wires; detach the wires after memorizing the combination of the wires and contacts.

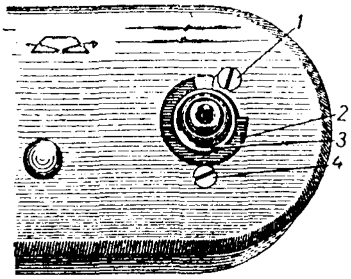


Figure 365. The winding clutch.

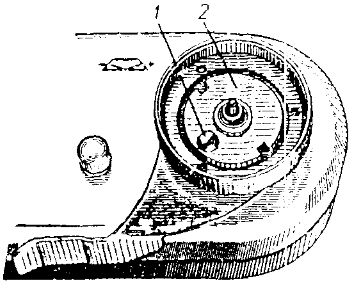


Figure 366. The winding lever parts in the latest models.

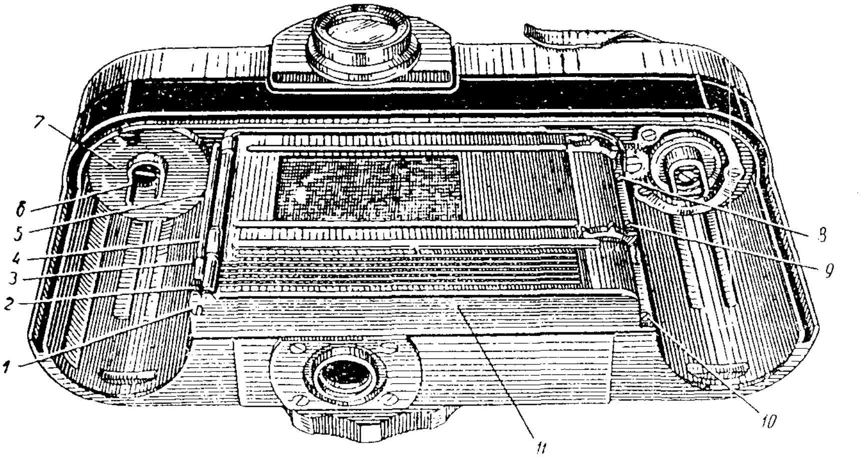


Figure 367. Camera with the plate removed.

Then remove the mechanism from the body making sure that the unfastened selftimer lever *3* (Fig.375a) does not get lost.

Camera reassembly is done in the reverse order. The disassembly sequence for camera mechanisms is given along with their description.

Camera Body and Removable Back Cover

The one-piece cast body (Fig.370) is very sturdy. It supports the flash synchronization contacts *1* and *2*, the selftimer release spring *4*, and the tripod nut *6* with the standard thread. The bayonet lens mount is located on the front side.

The back cover (Fig.371) is cast as well. The pressure plate *4* is made of glass and should therefore be protected from shock. The cover locks are similar to the locks in the "Zorki-2" camera (see p.140). They are sturdy and break rarely. All the parts of the lock are held together by the screw *2*. Sometimes the guiding screw of the lever *1* falls out, and the lock turns without restriction. In this case, disassemble the lock and install the screw. If the shafts of the guiding rollers *3* and *5* become worn and fall out, install them as described on p. 251.

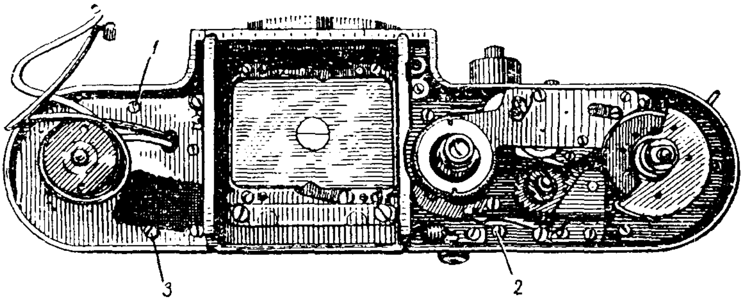


Figure 368. The top assembly panel.

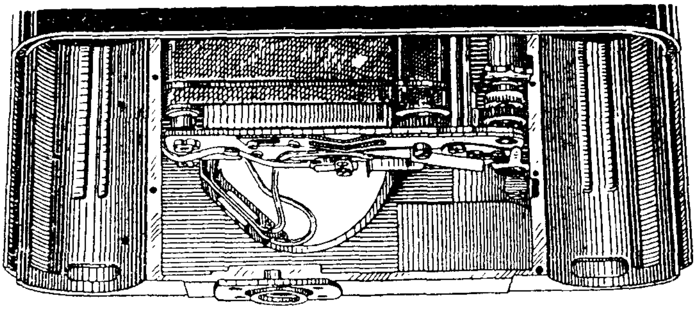


Figure 369. Removing the mechanism from the body.

The shutter winding of the focal plane, advancing the film to the next frame, setting the mirror in the working position, and counting exposures are all done by the winding mechanism that is activated by the turn of the winding lever *13* (Fig.360).

Design and operational principle. The winding lever is fastened on the bushing *9* (Fig.372). Figure 373 shows the bushing and slots for installation of the winding clutch *2* (Fig.365) or the lever (Fig.366). When the winding lever is turned, the winding bushing turns along with the disk *10* (Fig.372) located on it. There is a special device on the bottom of the bushing for connecting it with the winding gear *5* (Fig.373). This device resembles the brake device of the delay mechanism in the "Smena-2" camera (see Fig. 80d). When the winding lever is turned counter-clockwise, the rollers of the brake device are pressed against the gear *5* (Fig.373), and the gear starts rotating. When the winding lever returns to the starting position after the winding, the rollers are not pressed against the gear, and the gear remains still.

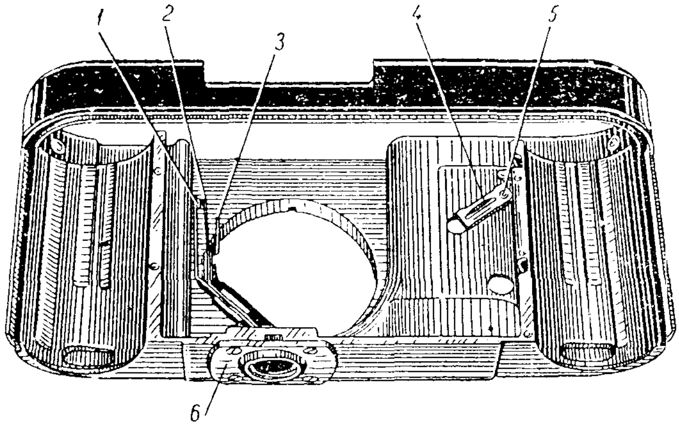


Figure 370. The camera body.

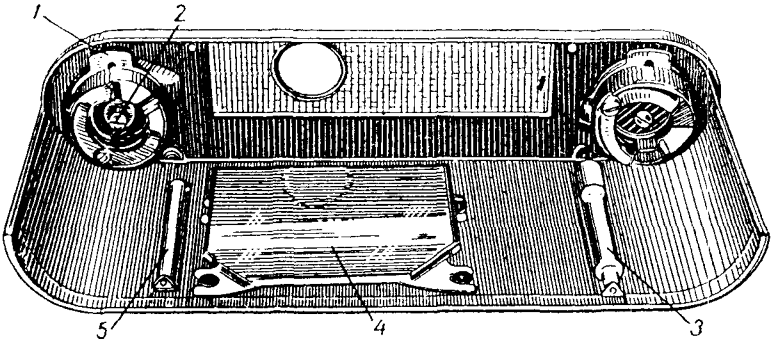


Figure 371. The removable back cover.

In the "Start" cameras where the winding lever is shaped as shown in Figure 366, the device that connects the winding bushing with the winding gear is somewhat different, but its operational principle is the same.

When the gear *5* (Fig.373) turns, it rotates the lower gear in the gear couple *2*, and the upper gear rotates the gear with the pin *14* (Fig.372). The pin is placed in the hole of the bushing *1* (Fig.373) which is connected with the gear *1* (Fig.374a). The gear *1* rotates the gear *4* that turns two wheels located one above the other. Their combined thickness is equal to the thickness of the gear *4*. The lower wheel and its shaft (Fig.374c) rotate the dial of the exposure counter *11* (Fig.360) and the friction clutch of the reeling fork.

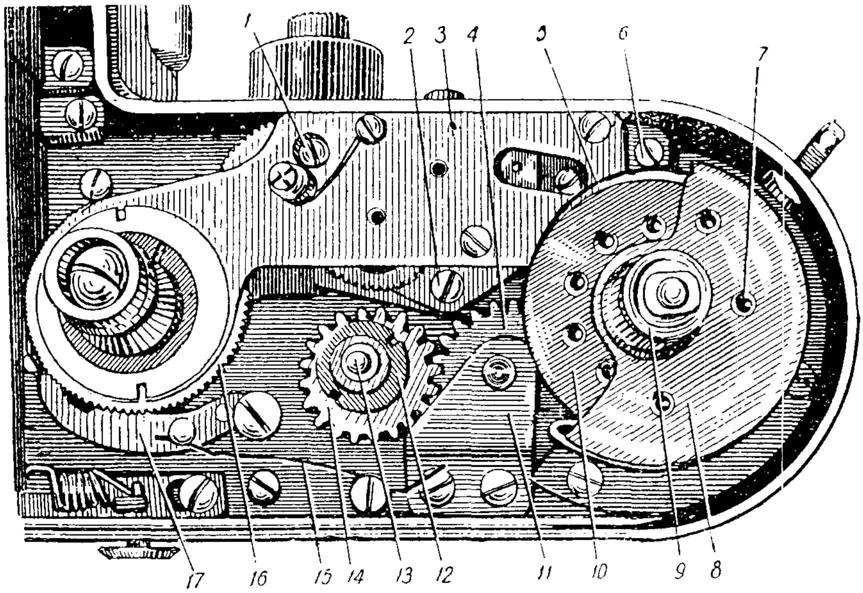


Figure 372. The top side of the winding mechanism.

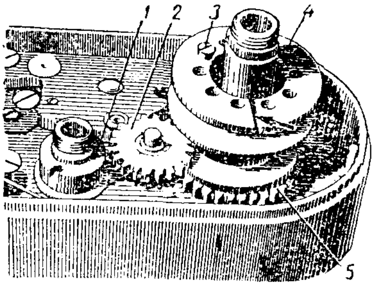


Figure 373. The parts of the winding mechanism.

The upper wheel and its bushing (Fig.374b) rotate the disk of the exposure counter *2* (Fig.362). The shaft of the lower wheel runs through the bushing of the upper wheel.

The reeling fork *6* (Fig.374a) rotates the take-up spool and coils the film around it. Due to the friction clutch, the reeling fork can skid and turn in the opposite direction at the time when the winding mechanism gears and the wheel *5* remain still. This is needed to allow the take-up spool to skid when the diameter of the film that is reeled around it increases and to make it possible to rewind the exposed film into the cartridge when a cartridge and a spool are used instead of two cartridges (it makes the spool rotate in the opposite direction). The film is pulled by the transport sprocket *10* that always turns at the same angle. The transport sprocket is connected with the gear *1* through two bushings.

The transport sprocket rotates the release gear *2* (Fig.376) with the aid of the pin *4*; the release gear winds the shutter and drives the mirror mechanism.

The winding mechanism includes the tape spring *5* (Fig.372) which returns the winding lever to the starting position. One end of the spring is hooked to the bracket *8*, and the other is placed into the disk's slot (see arrow in Fig. 373).

There are threaded holes on the edges of the disk *4*. One of them holds the screw *3*; the screw *7* (Fig.372) is screwed in from the bottom side on the bracket *8*. This is done to restrict the movement of the winding lever when it returns to the starting position. When the disk *10* is turned by the spring *5*, the screw on this disk reaches the screw *7*, and the disk stops.

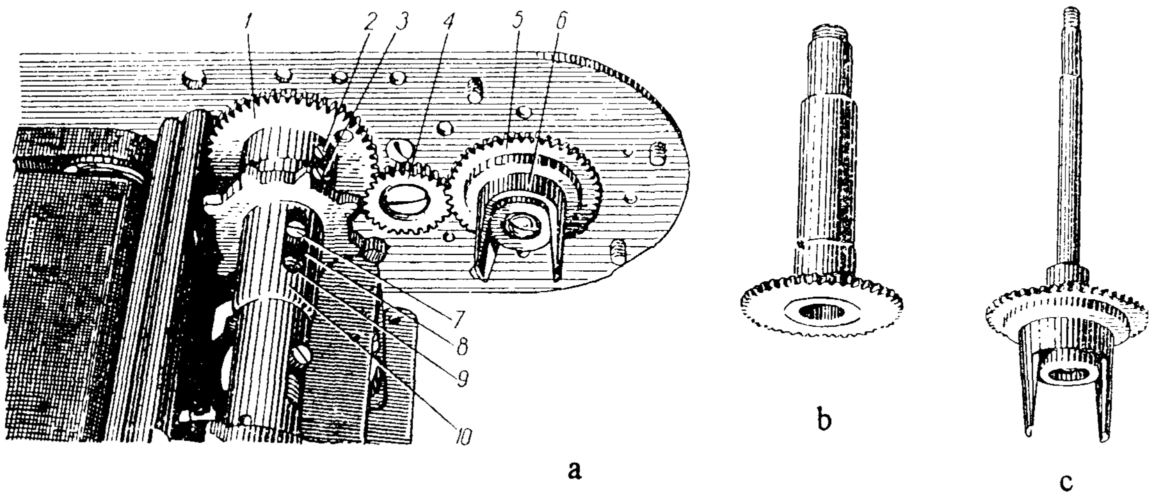


Figure 374. The bottom side of the winding mechanism:
a - in the assembled state; b - the wheel and bushing; c - the wheel and friction clutch of the reeling fork.

Mechanism malfunctions. 1. ***The winding lever moves freely*** in either direction, and the shutter mechanism cannot be wound. This is one of the most common camera malfunctions. The reason for it is the loosened nut *2* (Fig.363). To eliminate the problem, disassemble the top part of the mechanism and tighten the nut.

After the winding of the shutter, the winding lever is returned by the spring to the starting position and sets as shown in Figure 360. Once he is through shooting, the photographer turns the winding lever even farther and sets it next to the button *7*. Lever idling, as was pointed out above, is due to the cut out in the clutch *2* (see Fig. 365).

If the clutch turns and sets in the wrong position, it takes an extra effort to push the lever up to the button. This loosens the nut *2* (Fig.363), causing the described malfunction.

Thus, when correcting the problem, try to eliminate its cause at the same time. If you fail to do so, the nut is likely to become loose later.

Figure 365 shows the camera with the clutch in the wrong position while dotted line marks the correct position of the clutch.

The problem is resolved as follows. Remove the top shield, turn the disk *10* (Fig.372) counter-clockwise by half a turn, unscrew the thrust screw (it is shown in Fig. 373) and screw it in the adjacent hole on the left. As a result, the winding bushing and the winding clutch will slightly shift to the right. Then reassemble the camera.

To avoid this problem in later modifications of this camera (see Fig. 366), the winding mechanism's brake device is changed, and the nut *2* is secured with the set screw *1*.

2. ***The winding lever moves with difficulty, and the shutter cannot be wound.*** If the pin *2* (Fig.364) wears out or the edge of the cut-out in the winding clutch *2* (Fig.365) becomes deformed, the pin cannot catch the winding clutch when the winding lever turns. Install a new pin or correct the worn out edge of the pin with some sharp tool. File the edges of the cut-out winding clutch. When removing the winding lever, check whether the screws *1*, *3*, and *4* (Fig.364) are tightened.

3. ***The spring that drives the lever to the starting position has broken.*** The spring can be shortened. Remove the bracket *8* (Fig.372) fastened with three screws and take out the spring.

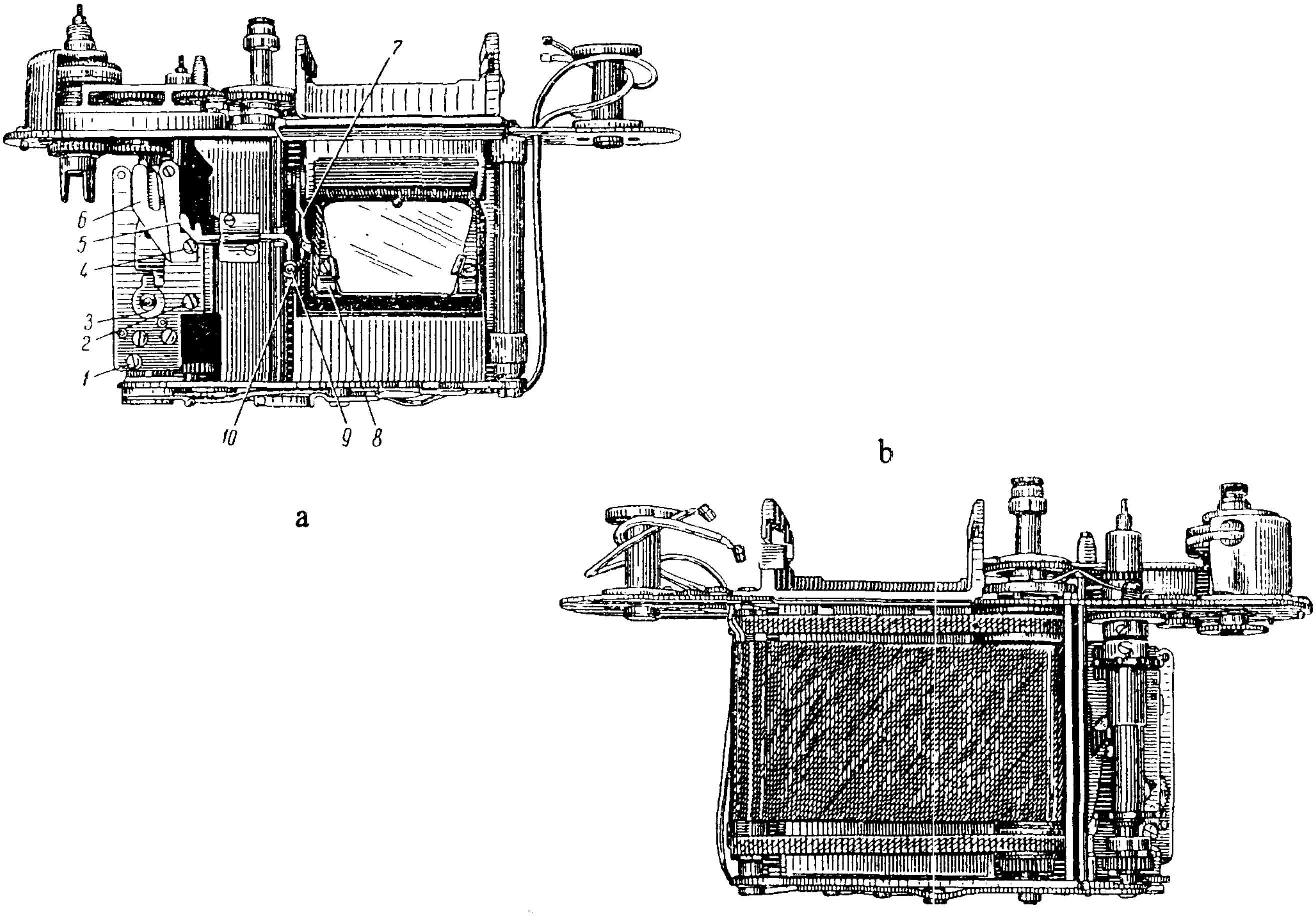


Figure 375. The focal plane shutter:
a - the front side of the shutter; b - the rear side of the shutter.

Having made a new bending in the spring, hook one end of the spring to the slot on the ring (see arrow in Fig. 373); unscrew the screw *3*, install the bracket, put on the winding lever, and turn it counter-clockwise to coil the spring around the disk and hook the bending on the spring's end to the hole in the bracket. When the spring is coiled, put in the thrust screw as described in item 1.

Shutter design in the "Start" (Fig.375), FED, and "Zorki" cameras is similar. However, the shutter body in "Start" is open, which makes access to all parts of the shutter easier. Thus, most repair, replacing the ribbon or curtain included, can be done without disassembling the shutter and in some cases without removing it from the camera body. Only the screen *11* (Fig.367) must be removed.

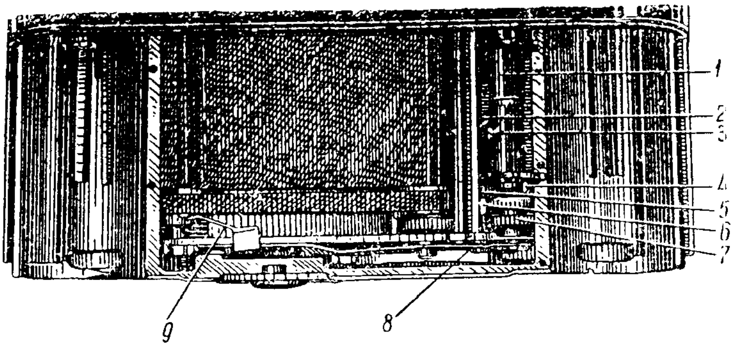


Figure 376. The shutter and release mechanism.

Figure 376 shows the shutter and release mechanism when the screen is removed. This disassembly is sufficient for replacing the ribbon or curtain. In any event, complete camera disassembly for repair should be avoided. First, remove the screen alone and try to fix the shutter; if this fails, remove the shutter from the camera body, and disassemble the shutter only as a last resort. To do that, disassemble the speed mechanism and unscrew the four screws on the top assembly plate fastening the shutter body posts. It is not recommended to disassemble the shutter

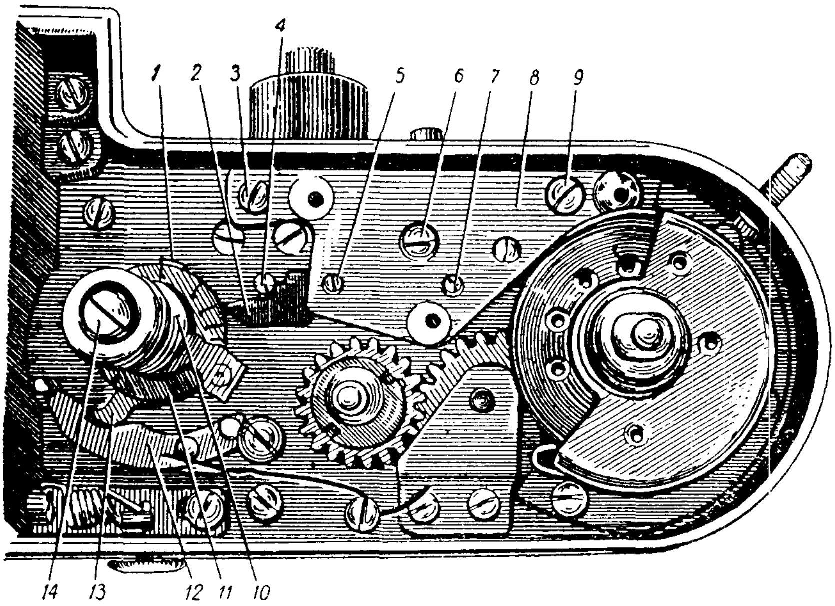


Figure 377. The base of the additional speed mechanism.

at this point because it requires taking apart of the mirror drive mechanism which is very complicated (see p. 304).

Most shutter malfunctions arise as a result of jamming of the mechanism gears with small pieces of film and other foreign objects. Thus, it is necessary to carefully examine and clean the gear teeth. In addition, certain winding mechanism malfunctions are sometimes mistaken for shutter malfunctions. Malfunctions of the shutter speed mechanism and film rewind switch which will be discussed below cause shutter malfunctions. As it follows from experience, shutter malfunctions are less common than malfunctions of other mechanisms connected with it.

The bottom side of the shutter body has a spring shock absorber *9* (Fig.376). During the operation of the shutter, the curtain's metal lath slides along the shock absorber which decreases its (the lath's) impact. The shock absorber spring is fastened with one screw whose shift can cause a shutter malfunction. The restrictive gear, like the similar gear *1* (Fig.128) in the FED camera, is fastened with a screw and a counter-nut *5* (Fig.132). Sometimes the screw of the gear becomes loose, and the shutter stops functioning. This problem can be rectified without disassembling the shutter. To do that, take the shutter out of the camera body and tighten the screw *7* (Fig.386) of the gear *6*. Lastly, tighten the set-nut *3* (Fig.380).

The "Start" camera shutter has one major improvement. Like most other cameras, it has a pin that is secured on the bottom plane of the shutter body and placed in the groove of the restrictive gear. Its purpose is to restrict the winding of the shutter and control the correct position of the cam *13* (Fig.377) relative to the center of the cut-out in the lever catch *12*. (The repair and adjustment are discussed in detail in the FED camera description.) In the "Start" camera, this pin is allowed to shift. The pin is located on the moving disk *4* (Fig.380) which is fastened with three screws.

The shutter speed mechanism consists of the exposure disk *11* (Fig.377), exposure lever *10* which is fastened with the screw *14*, cam *13*, and lever catch *12*. Its operational principle and interaction with the additional shutter speed mechanism are discussed in the "Zorki-4" camera description.

Additional shutter speed mechanism. The design, operational principle, and possible malfunctions of the additional shutter speed mechanism are discussed in detail in the "Zorki-4" camera description (see p. 174). In the "Start" camera, the location of the mechanism and its fastening are slightly altered. The additional shutter speed mechanism *3* (Fig.372) is fastened with the screws *1*, *2*, and *6*. To remove the mechanism, unscrew these screws and take them out. Then hold the gear *16* with two fingers, slightly lift the mechanism to release the cam, and carefully remove it.

When reinstalling the mechanism, first, install the part located under the disk *10* and put in the screw *6*. Next, put in the other screws and adjust the mechanism's operation.

The mechanism is installed on the base *8* (Fig.377) fastened with the screws *3*, *6*, and *9*. The lever-cutter *2* is similar to the one in the "Zorki-4" camera. It is driven by a spring and shifts along the guiding screws *5* and *7* that control the height of the base's *8* setting to allow the lever-cutter to move freely.

Shutter release mechanism. The shutter is released by pushing the button *3* (Fig.385). The rod of the button *1* (Fig.378a) presses the arm of the lever *2* (Fig.376) which, by pressing the screw *3* on the release gear *7* shaft, lowers the shaft and gear, and separates the pin *4* from the pin on the release gear.

When the release button is released, the rod *1* (Fig.378a) is driven to its starting position by the spiral spring inside the button. Simultaneously, the strong flat spring *8* (Fig.376) returns the release gear shaft and the screw *3* to the starting position. Besides that, there is a spring on the lever *2* that returns this lever to the starting position.

The shutter release can only occur if the screw *3* is located under the lever *2*, i.e., in the position shown in Figure 376. Since the transport sprocket 1 rotates during the winding of the shutter, the screw *3* is under the lever *2* only when the shutter is fully wound. If the shutter is not wound completely, its release will not occur.

The shutter release is also impossible if the mirror that is interlocked with the shutter does not fall when the release button is pushed. A detailed description of the mirror drive mechanism can be found on p. 304. The release button (Fig.378a) is unscrewed during camera disassembly. It is not recommended to disassemble this button. If during the unscrewing of the release button mechanism, the cylindrical bushing *4* unscrews too (the set screw *3* may fix it poorly) or the mechanism inside the button malfunctions, it is necessary to know the button's design and reassembly sequence. The release button mechanism consists of the base *1* (Fig.378b), cone-shaped spiral spring *2*, rod with a head *3*, pin *4*, bushing with two pins *5*, button with groove *6*, and cylindrical bushing *7*. To disassemble the button mechanism, unscrew the set screw *3* (Fig.378a) and the cylindrical bushing *4*.

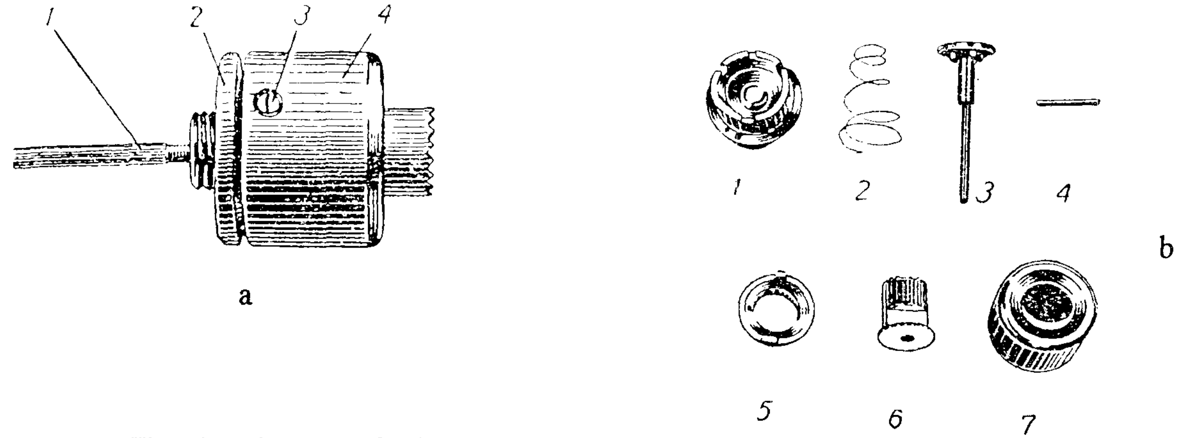


Figure 378. The release button mechanism:
a - assembled; b - disassembled.

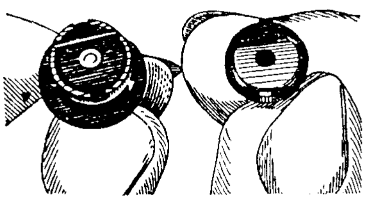


Figure 379. The release button mechanism assembly.

The button mechanism is reassembled as follows. Pick up the base *1* (Fig.378b) and put the spring *2* in its hole, with the larger diameter facing down. Install the rod *3*, and hold it down with your finger as shown in Figure 379 to prevent it from being pushed out by the spring. Then install the pin (see Fig. 379) for which there are two narrow slots in the base. Then place the bushing on the button, turn them upside down, and hold them with two fingers of your right hand (see Fig. 379). Connect both parts, turning the bushing and the button until the bushing pins slide into the wide slots of the base. Finally, put in the cylindrical bushing and the set screw *3* (Fig.378a).

Shutter malfunctions. In addition to the malfunctions described in the sections on shutters in the FED and "Zorki-4" cameras, the shutter in the "Start" camera may have several problems singular to this model.

1. ***A jammed shutter.*** This problem occurs if the shutter is being wound when the release button is depressed. Because of this the screw *3* (Fig.376) sets on the lever *2*, not under it. To correct the problem, push the button *7* (Fig.360).

This malfunction may also arise due to the deformation of the lever *2* (Fig.376) because of a loose screw fastening the lever. To correct this problem, remove the screen *11* (Fig.367) and check the operation of the shutter release mechanism.

2. ***One of the shutter curtains moves with difficulty.*** When the spring of the shock absorber *9* (Fig.376) is deformed, the curtain's metal lath catches the spring and detains the curtain. Check the position of the spring and its fastening screw (whether it is tightened up) when the screen *11* (Fig.367) is removed.

3. ***The shutter does not trip when the release button is pushed.*** In that case, you should immediately press the button *7* (Fig.360). If the shutter trips, it means that the shutter release mechanism is malfunctioning. The rod *1* (Fig.378a) may be deformed and miss the very narrow arm of the lever *2* (Fig.376). Remove the screen *11* (Fig.367) and watch whether the lever *2* (Fig.376) turns when the release button is pushed. If the lever does not turn, unscrew the release button *3* (Fig.385) and straighten out its rod. If the lever *2* (Fig.376) does turn when the release button is pushed, it means that the lever lowers the release button rod insufficiently and does not separate the pins *4*. You ought to check the lever *2* fastening and, if necessary, make the button rod longer. To do that, unscrew the button mechanism and slightly loosen the rod that is connected to the head with the aid of a thread.

4. ***The shutter speed knob 5 (Fig.360) is hard to set and is restrained by dial 6.*** This happens due to the displacement of the dial that is fastened with a nut located under the top shield *14*. Without removing the shield, use something to push the dial from the side and set it correctly.

Flash Synchronization Mechanism

The "Start" camera has two sockets for disposable bulbs and pulsed flashes. The middle insulated contact of each socket is wired to the contact mechanism, which interacts with the camera shutter and is a relatively complex part.

The flash synchronization mechanism has two electric circuits that become closed almost simultaneously when the shutter trips. The camera body serves as a part of the electric circuit. The first electric circuit of the disposable bulb is open in two locations.

First, the circuit is closed when the release button is pushed. When the shutter release button is depressed, the spring *2* (Fig.380) lowers and closes the circuit on the contacts *5* and *6*. Unlike the contact *6* the contact *5* is not insulated from the camera body. The contact *6* is located between the insulating washers *7*. The second end of the wire *12* is attached to the contact *6*.

At the same moment the circuit closes in the second location. The mirror falls and pushes the lever *3* (Fig.370) which is installed on the contact *2*; this lever tilts the contact and closes the circuit through the contact *2* and the contact of the contact *1*. The contact mechanism is visible when the lens and the shield *9* (Fig.385) are removed. The ends of the wires *12* and *13* (Fig.380)

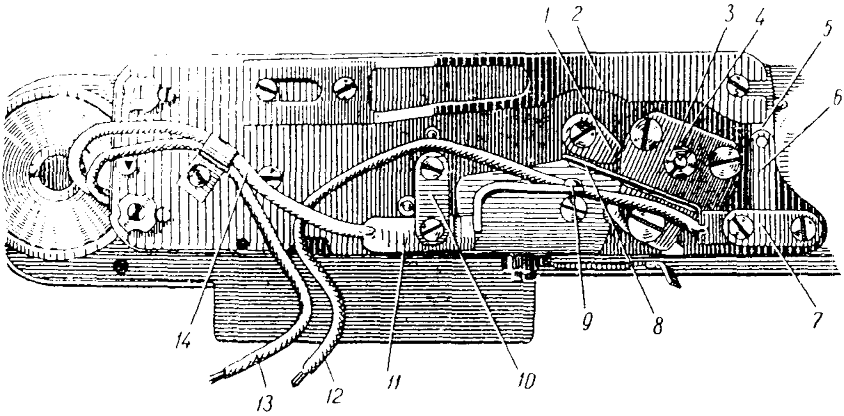


Figure 380. The contact mechanism.

are soldered to the contacts *1* and *2* (Fig.370). Therefore, at the moment when the mirror falls, the circuit is closed through the wires *12* and *13* (Fig.380). The second end of the wire *13* is connected with the interior insulated contact of the socket *7* (Fig.385). If a disposable bulb is plugged into the socket at this moment, the electric circuit will close and the bulb will go off. The electric circuit closes a moment before the shutter trips. This happens because the mirror pushes the lever *3* (Fig.370) and closes the circuit on the contacts *2* and *1* before the mirror reaches the starting position and opens the interlocking mechanism that allows the shutter to trip.

The second electric circuit - the circuit of the pulsed flash - is closed in two locations as well. The circuit is closed on the contacts *5* and *6* (Fig.380) as well as contacts *8* and *9*. Contact *8* is a bending of the contact *6*, and contact *9* is a bending of the contact *11*. The contact *11* is placed between the insulated washers *10* and is insulated from the body. When the shutter trips, the curtain drum shaft turns. The cam *1* attached to it reaches the contact *8* and closes the electric circuit on it and the contact *9* contact. This happens at the moment when the first curtain returns to its starting position and the shutter is fully open. One end of the wire *14* is soldered to the contact *11*, while the other end is connected with the insulated contact of the socket *6* (Fig.385). If the pulsed flash is plugged into the socket at this time, the electric circuit will close and the flash will go off.

Flash synchronization mechanism malfunctions are uncommon. 1. ***A broken electric circuit.*** This malfunction arises when the circuit is not closed on the contacts *5* and *6* (Fig.380) or *8* and *9* during the operation of the shutter. Remove the screen *11* (Fig.367) and observe the operation of the contacts, particularly the contacts *8* and *9*. Slightly elevate the contact *9*.

When the camera has been used for a long time, the contacts may become burned. Gently clean them to correct the malfunction.

Check whether the cam *1* (Fig.380) is secured well and whether insulation of the socket interior contacts is intact.

2. ***The electric circuit closes at the wrong time.*** This happens if the circuit is closed on the contacts *8* and *9* too early. Slightly lower the contact *9*.

Selftimer

The selftimer mechanism is similar to the mechanism in the "Zorki" cameras (see p.149). It is fastened on the shutter body with the screws *1*, *2*, and *4* (Fig.375a). When the selftimer is in the working mode, the lever *5* (Fig.376) pushes the rod *6* which lowers the flat spring *8* and releases the shutter. However, the shutter cannot be released until the mirror falls. Therefore, the mirror has to be lowered at the same time with the selftimer mechanism's release. As in the "Zorki-4" camera, the selftimer mechanism is released by a push of the button *4* (Fig.385) that presses the spring *6* (Fig.375a) and frees the mechanism pallet. Simultaneously, the release button presses the spring *4* (Fig.370) that turns the lever *5* (Fig.375a) and releases the mirror. The mirror returns to the starting position and opens the interlocking mechanism.

There is a hole inside the release button *4* (Fig.385) which holds a screw glued with shellac. The tip of the screw *5* (Fig.370) runs through the hole in the spring *4* and pushes the spring *6* (Fig.375a) when the release button is depressed. This activates the selftimer mechanism. Therefore, the wide part of the release button pushes the spring *4* (Fig.370), and the screw inside the button presses the selftimer spring.

The screw *5* simplifies the selftimer adjustment described in Malfunction 2 on p.151. The adjustment no longer requires the removal of the release button or inserting the washers. S
All you should do is slightly loosen or tighten the screw *5*.

It is enough to remove the screen *11* (Fig.367) for the selftimer adjustment. However, you must take the shutter mechanism out of the body when complicated repair is necessary.

Film Rewind Switch Mechanism

The transport sprocket engagement switch for the film rewind is similar to the mechanisms in the "Zorki-4", "Zenit-3" and other cameras (see p.145).

When the focal plane shutter is wound, the gear *14* (Fig.372) rotates, turning the clutch *1* (Fig.373) with the aid of a pin placed in its hole. The lower end of the clutch has two slots holding the pins of the clutch *8* (Fig.374a) inside the transport sprocket *9*. The clutch *8* moves and is pressed against the upper clutch by the spiral spring *9*. The screw *7* connects the clutch with the transport sprocket.

One switch mechanism malfunction is common - the slots of the connecting clutch *1* (Fig.373) wear out. To correct this problem, remove the top shield *14* (Fig.360), unscrew the bushing *12* (Fig.372) and remove the rod *13*. There is a washer on top of the bushing which must be removed and installed at reassembly. Remove the gear *14*. To unscrew the clutch *1* (Fig.373), remove the screws *2* and *3* (Fig.374a) first. Correct the clutch slots with a file.

Lens

The "Start" camera is equipped with the "Helios-44" lens (Fig.381) which has a pressure diaphragm that automatically stops on a preset value when the release button is pushed. To allow the diaphragm blades to turn easily, they are made of very thin metal sheets and have metal balls under the crown. The diaphragm is very complex and should be disassembled by highly skilled experts only.

The specifications of the lens can be found on p. 240. The optical diagram is shown in Figure 299.

Lens design and disassembly. The lens is complex. It consists of an exterior mount (Fig.383) which holds the diaphragm drive mechanism and block (Fig.384) where the optical parts and the diaphragm are mounted. Lens disassembly (i.e., removing the block from the exterior mount) should be done only as a last resort. This is how it is done. Set the lens mount in the ∞ position and, after loosening the three set screws, remove the ring *6* (Fig.382). Then loosen the four set screws on the sides of mount *2* (the screw *3* is shown in the Figure), make a mark on the block ring *4* next to the screw *3*, and carefully remove the block. The mark is needed for future proper installation of the block.

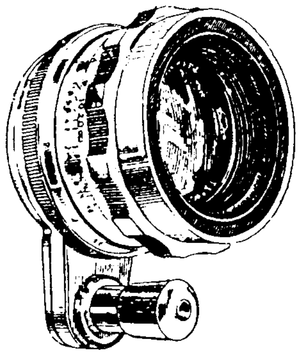


Figure 381. The "Helios-44" lens.

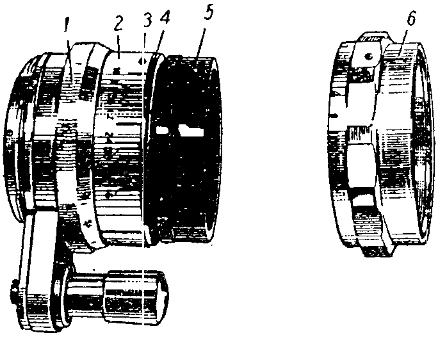


Figure 382. The parts of the lens mount.

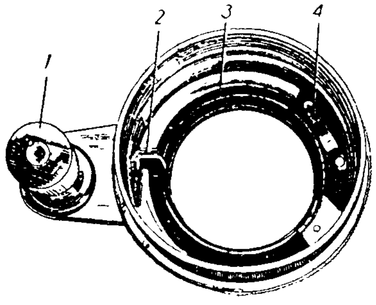


Figure 383. The exterior mount and diaphragm drive mechanism.

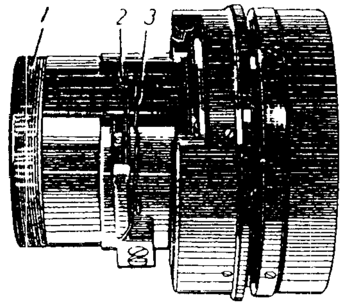


Figure 384. The lens block.

The iris diaphragm consists of thirteen blades. One of them (it is lighter) is made in the shape of a lever turning on a shaft. The bushing *2* (Fig.384) is installed on the end of this lever;

the bending of the spring *3* is hooked to the bushing. When the bushing *2* is pushed, the lever turns and rotates the diaphragm crown. The spring *3* drives the diaphragm blades to the starting position.

The diaphragm lever turns the lever *2* (Fig.383). When the button *1* is pushed, a special device turns the lever *2*. The angles of the lever's turn can vary, and they depend on the set diaphragm. The smaller the diaphragm's hole, the larger the angle of the lever's turn. The size of the diaphragm's hole is controlled by the ring *3*. There is another lever under the lever *2* which is pressed by a spring against the elliptic surface of the ring *3*. When the ring turns, the lever controlling the rotation angle of the lever *2* turns along with it.

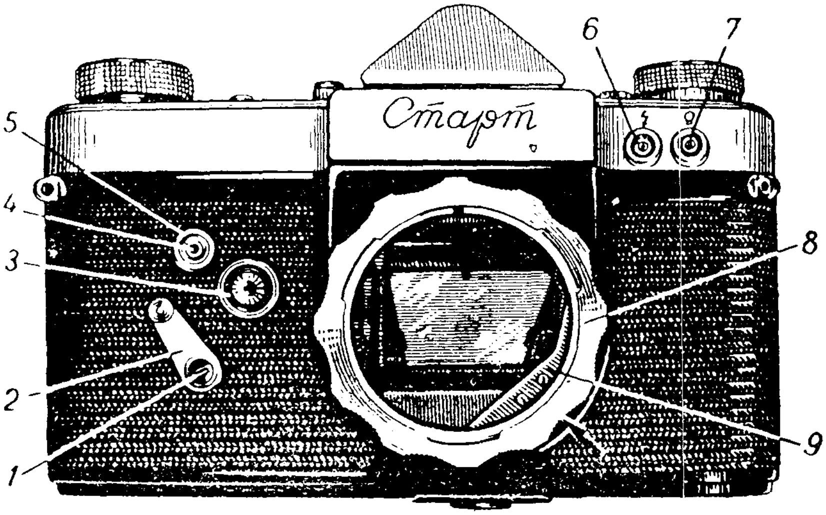


Figure 385. The front of the camera.

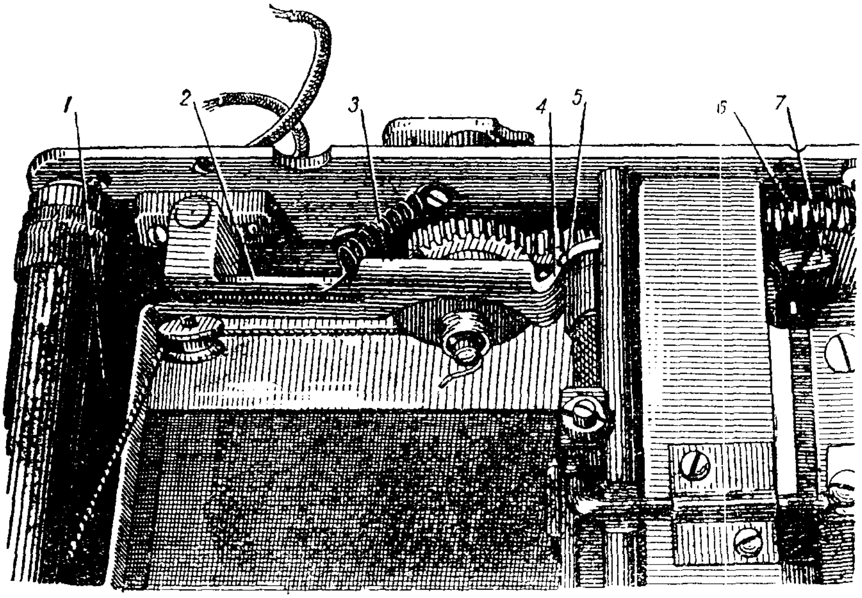


Figure 386. The mirror drive mechanism.

A metal ball is placed inside the hole in the ring *3* and pressed by the spring *4*. The mount surface under the ring has grooves where the ball falls at the turn of the exterior ring *1* (Fig.382). The exterior ring connected with the ring *3* (Fig.383) by a screw. The number of grooves corresponds to the number of diaphragm values. This is how the exterior ring is fixed when setting a diaphragm value.

The lever *2* is located in front of the bushing *2* (Fig.384) and turns at any diaphragm setting, even if it is fully open, i.e., at the "2" value. However, the lever's turning angle at this diaphragm is small, and the lever merely reaches the bushing, whereas at all the other diaphragm values it turns the diaphragm lever.

The diaphragm mechanism's operation can be observed when the rear component *1* is removed and the lever *2* is pressed with a finger.

When the lens block is being mounted, set the exterior ring *1* (Fig.382) in the "2" position and the lever *2* (Fig.383) in the starting position to place it behind the bushing *2* (Fig.384).

The lens cleaning is described on p. 31. Without disassembling the lens remove the rear component which has two slots for the key. Do not confuse the component mount slots with those of the rear lens element rim. To remove the front lens, unscrew the ring *5* (Fig.382).

Lens bayonet. The lens is fastened to the camera with the aid of the bayonet *8* (Fig.385), which is very convenient if you need to change the lens quickly. The bayonet is screwed onto the protruding part of the camera body. To remove the bayonet, unscrew one screw (see arrow on Fig. 385).

Viewfinder-Rangefinder

The optical diagram of the viewfinder-rangefinder in the "Start" camera is the same as the one in the "Zenit" camera (see Fig.276). The only difference is that the roof-like pentaprism (Fig.277) in the "Start" camera is removable and has an additional optical wedge focusing device. A detailed description of the viewfinder-rangefinder design can be found on p.223.

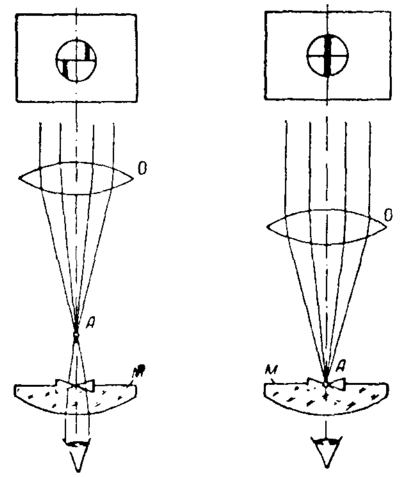


Figure 387. A diagram of the optical wedge focusing device.

Mirror drive mechanism. The moving mirror sets in the *AB* position (Fig.276) at the winding of the shutter and returns to its starting position at the moment when the shutter trips. The mirror drive mechanism (Fig.386) has a design similar to the drive mechanism in the "Zenit-C" camera whose detailed description is given on p.231.

The shapes of the lever *1* and its arm *2* (Fig.386) are slightly changed. The bending *4* of the lever *2* is pressed by the spring *3* against the pulley *5* and blocks its turning until the mirror falls, pushes the lever *1*, and turns the arm *2*.

In the "Start" camera, changes are made in the part of the mechanism that fixes the mirror in the working position and releases it. This function is accomplished by the lever *4* (Fig.285) in the "Zenit" camera and by the lever *7* (Fig.375a) in the "Start" camera. When the shutter is being wound, the mirror lowers, and its frame *8* is fixed by the shoulder of the lever *7*. When the shutter is released, the wide part of the release button pushes the lever *5* that turns and elevates the lever *7*, and the mirror falls.

Mechanism malfunctions. In addition to the malfunctions similar to those of the mirror drive mechanism in the "Zenit-C" camera, the "Start" camera may have the following problems.

1. ***The mirror lowers during the winding of the shutter, but falls immediately without setting in the working position.***

2. ***The mirror does not fall when the release button is pushed.*** Both malfunctions occur due to the same factor - the incorrect adjustment of the lever *7* (Fig.375a). Check the mobility of the lever; it has to go up when the release button is pushed and then return to the starting position with the help of a spring.

You should also check to see whether the set-nut *10* fixing the screw *9* is fully tightened. This screw controls the height of the lever *7* setting. The lower the screw, the more elevated the lever *7* and the smaller the area *8* held by its shoulder. Therefore, the lever *7* will free the mirror faster when the release button is pushed. Sometimes the nut *10* becomes loose or even falls out along with the screw *9*. In that case, the lever *7* sets lower, and the mirror does not fall at the push of the release button. To turn the screw *9*, unscrew the nut *10* and put it back after the adjustment of the lever *7*.

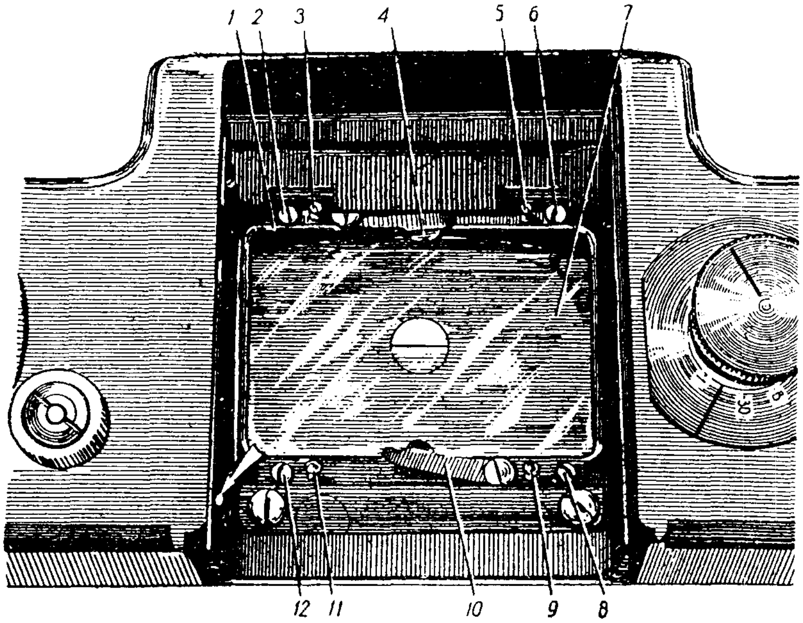


Figure 388. The collective lens element of the viewfinder.

Having completed this job, check the rangefinder adjustment.

Focusing the optical wedges. The ground plane of the collective lens element *7* (Fig.388) has a groove in the center for two semi-circular optical wedges (prisms). The optical wedges look like a transparent circle divided by a thin line. The tilted planes of the optical wedges intercept at point *A* (Fig.387b), matched with the ground plane *M* of the collective lens element.

At the beginning of the lens focusing, the plane of the object image is always either in front of the collective lens element ground plane or behind it (Fig.387a). The image viewed in the circle of the optical wedge device appears split in two parts shifted relative to each other. The lens focusing is done by turning the lens mount until the plane of the object image coincides with the ground plane of the collective lens element (Fig.387b), and the outlines of the image visible in the circle of the optical wedge device merge. This position, in effect, comprises correct camera focusing. The optical wedge angle serves as a basis for the optical wedge rangefinder with no moving parts.

The focusing optical wedge device makes focusing with insufficient light much easier due to the transparent optical wedges that let in more light than does the ground surface of the collective lens element.

Camera Adjustment

The "Start" camera adjustment consists of the body and lens adjustment and viewfinder-rangefinder adjustment.

The body and lens adjustment is done very rarely because the body is cast under pressure and is very sturdy. The misadjustment of the camera working distance is uncommon (see p.18).

Viewfinder-rangefinder adjustment. The viewfinder-rangefinder adjustment is much simpler than in other reflex cameras.

To check the correct rangefinder operation, focus the camera on an infinitely distant object (a distance of 100 m or more) and, while looking into the eyepiece of the viewfinder-rangefinder, turn the lens mount until the sharpest possible image appears on the ground plane of the collective lens element. Then look at the range scale on the lens mount. If the scale is not in the ∞ position, the viewfinder-rangefinder needs adjustment.

The viewfinder-rangefinder adjustment is carried out by the collective lens element *7* (Fig.388) placed in the mount-frame *1* and secured with the holders *4* and *10*. To elevate or lower the collective lens element, you should elevate or lower the frame *1*. The position of the frame is controlled with the thrust-adjusting screws *3*, *5*, *9*, and *11*.

Remove the pentaprism and loosen the screws *2*, *6*, *8*, and *12* by one turn. Then adjust the position of the frame with the collective lens element by using the screws *3*, *5*, *9*, and *11*. If the pointer stops short of the ∞ index on the lens mount, the collective lens element has to be elevated. If it goes past this index, the lens element has to be lowered. To do that, rotate the screws *3*, *5*, *9*, and *11* by 1/3-1/2 turn, keeping in mind that the turning angle for all screws has to be the same. Tighten the screws *2*, *6*, 8, and *12* after correctly positioning the collective lens element.

The Author

Isaak Maizenberg is probably the country's leading authority on Russian cameras - their history and mechanics.

This book, long overdue, is written for the collector, the user and, most of all, the camera enthusiast - one of the growing collector groups in America - as well as a vast number of international devotees accruing collections of Russian cameras. The book is a main source of "how-to" in understanding these cameras and how to repair them.

The author's forty-plus years in the art of camera restoration and repair have covered the world's leading photo instruments. While the Leica has been his prime camera, his experience includes a vast array of Russian copies of leading international brands, as well as Russian designed originals.

Isaak's special engineering background and experience have allowed him the title of"expert" in the field of camera repair. In addition to his 11 books written in this field he has also authored over 200 articles on the camera and the care thereof. Among the leading collectors, as well as prominent dealers, Isaak's "know-how" has served a vast number, returning their cameras to restored and actively working photographic instruments.

For those who want to go further, and consider working on their own cameras, let this guide serve you. For those who just "collect", let this book serve as a vital guide to understanding the Russian contribution to the art of the optic and of the camera.

The introduction inside the book starts you off with identification of the models from 20s to the 60s, and leads you into the exciting world of Russian cameras.

Mr. Maizenberg's vast hands-on experience in the art of repair and restoration brings you a unique reference guide to which you can refer for many years.

The author's Introduction best details the contents and span of coverage of Russian cameras.